FISHERY RESEARCH

SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM RESEARCH ELEMENT

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SNAKE RIVER SOCKEYE SALMON CAPTIVE BROODSTOCK PROGRAM RESEARCH ELEMENT

Project Progress Report

2000 Annual Report

By

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ABSTRACT

On November 20, 1991, the National Marine Fisheries Service listed Snake River sockeye salmon *Oncorhynchus nerka* as endangered under the Endangered Species Act of 1973. In 1991, the Shoshone-Bannock Tribes and Idaho Department of Fish and Game initiated the Snake River Sockeye Salmon Sawtooth Valley Project to conserve and rebuild populations in Idaho. Restoration efforts are focusing on Redfish, Pettit, and Alturas lakes within the Sawtooth Valley.

The first release of hatchery-produced juvenile sockeye salmon from the captive broodstock program occurred in 1994. The first anadromous adult returns from the captive broodstock program were recorded in 1999 when six jacks and one jill were captured at Idaho Department of Fish and Game's Sawtooth Fish Hatchery. In 2000, progeny from the captive broodstock program were released using four strategies: eyed-eggs were placed in Pettit Lake; age-0 presmolts were released to all three lakes in October; age-1 smolts were released to Redfish Lake Creek, and hatchery-produced adult sockeye salmon were released to Redfish and Alturas lakes for volitional spawning in September. Anadromous adult sockeye salmon were released to all three lakes.

Total kokanee abundance in Redfish Lake was estimated at 10,268, which was the lowest abundance since 1991. Abundance of kokanee in Alturas Lake was estimated at 125,462, which was one of the highest values recorded since 1991. Abundance of kokanee in Pettit Lake was estimated at 40,599, which is the third highest value recorded since 1991.

Upon the recommendation of the Stanley Basin Sockeye Technical Oversight Committee, the National Marine Fisheries Service reopened the kokanee fishery on Redfish Lake in 1995 in an attempt to reduce kokanee numbers. Anglers fished an estimated 3,063 hours and harvested approximately 67 kokanee during the 2000 season. Angler effort and harvest were also monitored on Alturas Lake during 2000. Effort on Alturas Lake was 5,190 hours, and harvest of kokanee was 407 fish. Anglers harvested an estimated 11% of the catchable rainbow trout planted into Alturas Lake.

The out-migrant trap on Redfish Lake Creek was operated from April 12 to June 14, 2000. A total of 126 wild/natural and 2,378 hatchery-produced sockeye salmon smolts were captured, and total out-migration was estimated at 302 wild/natural and 6,926 hatchery-produced smolts.

Estimates of smolt out-migration to Lower Granite Dam (LGR) were made by release strategy and were based on PIT-tag interrogations. An estimated 115 wild/natural smolts passed LGR from Redfish Lake. An estimated 6,987 hatchery-produced smolts released as presmolts into Sawtooth basin lakes passed LGR. None of the 148 age-1 smolts released to Redfish Lake Creek were detected at LGR.

Two hundred fifty-seven anadromous sockeye returned to the Sawtooth basin in 2000. All were progeny of the captive broodstock program. The majority (200) of the adults that returned were released back to lakes in the basin for natural spawning along with hatchery-produced adults. Redfish Lake received 164 adult sockeye salmon, and 20 to 29 areas of excavation were sighted. Alturas Lake received 77 adult sockeye salmon, and 14 to 19 areas of excavation were sighted. Pettit Lake received 28 adult sockeye salmon. No areas of excavation

were noted in Pettit Lake, but spawning was suspected to have occurred in water too deep for observation.

Index reaches on principal tributary streams of Redfish and Alturas lakes were surveyed in August and September 2000 to track bull trout population response to no-harvest fishing regulations. Similar numbers of adult bull trout were observed in both systems, but twice as many redds were observed in Fishhook Creek. Redd counts in both streams have increased since monitoring began in 1998.

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INTRODUCTION

Snake River sockeye salmon *Oncorhynchus nerka* were listed as endangered under the Endangered Species Act (ESA) by the National Marine Fisheries Service (NMFS) on November 20, 1991. Residual (nonmigratory) sockeye salmon were discovered in Redfish Lake and added to the listing in 1992.

When the petition for listing was filed in 1991, the presence of two populations of *O. nerka* (resident kokanee and anadromous sockeye salmon) in Redfish Lake complicated the decision to list the species as endangered. The population proposed for listing was the sockeye salmon population, an anadromous form of *O. nerka* that spawns on the shoals of the lake in October and November. Juvenile sockeye salmon spend one or two years in the lake prior to smolting and migrating to the Pacific Ocean. Adult sockeye salmon spend one, two, or three years in the ocean before returning to Redfish Lake to spawn. The resident form of *O. nerka* (kokanee) spawns in Fishhook Creek, a tributary to Redfish Lake, in August and September and spends their entire lives in Redfish Lake. A third form of *O. nerka* was discovered in Redfish Lake in 1992. This form, known as residual sockeye salmon, spawns with the anadromous sockeye on the lakeshores in October and November and is genetically similar to the anadromous sockeye salmon. The residual form spends its entire life in Redfish Lake, and its progeny spend one or two years in the lake before smolting and migrating to the ocean.

The decision to list Snake River sockeye salmon as endangered required that they meet the definition of a “species” as defined by the ESA. Waples (1991) defined “species” as it pertains to pacific salmon. The definition of a species is interpreted to include any subspecies of fish or any distinct population segment or evolutionarily significant unit (ESU) of any species that interbreeds when mature. Two criteria must be met for a population to be considered an ESU and, therefore, a species: it must be reproductively isolated, and it must represent an important component in the evolutionary legacy of the species. Reproductive isolation does not have to be absolute, but it must be strong enough to allow evolutionarily important differences to accrue in different population units (Waples 1991).

Studies conducted after the listing of Snake River sockeye salmon as endangered clarified the genetic relationships between anadromous sockeye salmon, residual sockeye salmon, and resident kokanee. Waples et al. (1997) stated that there were two distinct gene pools of *O. nerka* in Redfish Lake: one consisting of Redfish Lake kokanee, the other of anadromous and residual sockeye salmon. As a result of the new information, the Snake River sockeye salmon ESU was defined to specifically exclude the Fishhook Creek kokanee population from ESA protection.

In Idaho, only the lakes of the upper Salmon River (Sawtooth basin) remain as potential sources of production for sockeye salmon. Historically, five Sawtooth basin lakes (Redfish, Alturas, Pettit, Stanley, and Yellowbelly) supported sockeye salmon (Bjornn et al. 1968). Current recovery efforts are focusing on Redfish, Pettit, and Alturas lakes. Since 1991, 16 wild and 264 hatchery-produced adult Snake River sockeye salmon have returned to the Sawtooth basin from the Pacific Ocean.

The Idaho Department of Fish and Game (IDFG) is charged with the responsibility of reestablishing sockeye salmon runs to the Sawtooth basin, with emphasis placed on efforts to utilize endemic sockeye salmon stocks (IDFG 1992). The Snake River Salmon Sawtooth Valley Project was started in 1991 as a cooperative effort between the Shoshone-Bannock Tribes

(SBT), NMFS, and IDFG with the goal of conserving and rebuilding sockeye salmon populations in Idaho. Bonneville Power Administration (BPA) funds the project. Coordination and guidance for the recovery effort is provided by the Stanley Basin Sockeye Technical Oversight Committee (SBSTOC), composed of biologists representing the agencies involved in the recovery and management of Snake River sockeye salmon. Research and recovery activities associated with Snake River sockeye salmon are permitted under the ESA (NMFS Permit Nos. 1120, 1124, and 1233).

Idaho Department of Fish and Game participation in the Snake River Salmon Sawtooth Valley Project covers two areas of effort: 1) the sockeye salmon captive broodstock program, and 2) Sawtooth basin fisheries research. While objectives and tasks from both components overlap and contribute to achieving the same goals, work directly related to the captive broodstock program appears under a separate cover (Kline and Willard 2001). This report details fisheries research information collected between January 1, 2000 and December 31, 2000, including Sawtooth basin lakes kokanee population monitoring, sport fishery evaluation on Redfish and Alturas lakes, smolt out-migration monitoring and evaluation at lake outlets, telemetry studies of mature adult sockeye salmon released to Sawtooth basin lakes, and predator investigations in tributaries to Redfish and Alturas lakes.

PROJECT GOAL

The goal of IDFG captive broodstock development and evaluation efforts is to recover sockeye salmon runs in Idaho waters. Recovery is defined as reestablishing sockeye salmon runs and providing for utilization of sockeye salmon and kokanee resources. The immediate project goal is to maintain this unique sockeye salmon population through captive broodstock technology and avoid species extinction.

PROJECT OBJECTIVES

1. Develop captive broodstocks from Redfish Lake anadromous sockeye salmon.

2. Determine the contribution hatchery-produced sockeye salmon make toward avoiding population extinction and increasing population abundance.

3. Describe kokanee population characteristics for Sawtooth basin lakes in relation to carrying capacity and broodstock program supplementation efforts.

4. Refine our ability to discern the origin of wild and broodstock sockeye salmon to provide maximum effectiveness in their utilization within the broodstock program.

5. Technology transfer.

STUDY AREA

Recovery efforts for Idaho sockeye salmon focus on Redfish, Alturas, and Pettit lakes in the Sawtooth basin (Figure 1), located within the Sawtooth National Recreation Area. Basin lakes are glacial-carved, ranging in elevation from 1,985 m to 2,138 m (Table 1) and receive runoff from the Sawtooth and Smokey mountains. Lakes in the Sawtooth basin are considered oligotrophic. The lakes are part of the upper Salmon River watershed. The Salmon River flows into the Snake River, then the Columbia River, which drains into the Pacific Ocean. The Sawtooth basin is approximately 1,450 river km from the mouth of the Columbia River at the Pacific Ocean.

In addition to *O. nerka*, numerous native and nonnative fish reside in the study lakes and streams within the Sawtooth basin. Native fish present in Sawtooth basin waters include: chinook salmon *O. tshawytscha*, rainbow trout/steelhead *O. mykiss*, westslope cutthroat trout *O. clarki lewisi*, bull trout *Salvelinus confluentus*, sucker *Catostomus spp*., northern pikeminnow *Ptychocheilus oregonensis*, mountain whitefish *Prosopium williamsoni*, redside shiner *Richardsonius balteatus*, dace *Rhinichthys spp*., and sculpin *Cottus spp*. Nonnative species present in Sawtooth basin waters include lake trout *S. namaycush* (Stanley Lake only) and brook trout *S. fontinalis*. Rainbow trout are released into Pettit, Alturas, and Stanley lakes in the summer to increase sport-fishing opportunity. Sport fishing on Pettit, Alturas, and Stanley lakes is covered by Idaho's statewide general fishing regulations, which allow fishing year round and harvest of six trout per day (excluding bull trout which must be released if caught) and 12 kokanee per day (IDFG 2000). Sport-fishing regulations on Redfish Lake restrict kokanee fishing/harvest to January 1 through August 7 to protect residual sockeye salmon. No trout have been stocked in Redfish Lake since 1992.

Captive Broodstock Program Egg and Juvenile Supplementation

The IDFG captive broodstock program annual report appears under a separate cover (Kline and Willard 2001), but due to the nature of this project, a discussion of the supplementation of hatchery-produced sockeye salmon that occurred in 1999 and 2000 to Sawtooth basin waters is provided.

All hatchery-produced sockeye salmon released to Sawtooth basin waters were adipose fin-clipped, and a portion were Passive Integrated Transponder (PIT) tagged before release. One hundred fish from each release group were measured for fork length (1 mm) and weight (0.1 g) during PIT tagging. Mean release weights were collected at the hatchery before release using grab sample counts.

In 1999, 70,321 sockeye salmon were released into Sawtooth basin waters from the captive broodstock program (Table 2). Redfish Lake received 23,886 age-0 presmolts released directly to the lake in October. Twenty-one brood year 1996 hatchery-produced adults were released for volitional spawning directly to Redfish Lake in September (10 hatchery-produced females, eight hatchery-produced males, and three anadromous males of hatchery origin). Alturas Lake received 12,955 presmolts released directly to the lake in October. Pettit Lake received 3,430 age-0 presmolts released directly to the lake in October and 20,311 eyed eggs planted in egg boxes in November. Redfish Lake Creek and the upper Salmon River received 4,859 age-1 smolts (brood year 1997) each. All presmolts released in 1999 were from brood year 1998 and were reared at the IDFG Sawtooth Fish Hatchery, Stanley, Idaho.

In 2000, 137,731 sockeye salmon were released into Sawtooth basin waters from the captive broodstock program (Table 3). Redfish Lake received 48,051 age-0 presmolts released directly to the lake in October. All presmolts released to Redfish Lake were from brood year 1999 and were reared at the IDFG Sawtooth Fish Hatchery. Forty-six brood year 1997 hatchery-produced adults were released for volitional spawning directly into Redfish Lake in September. Ten of the hatchery-produced adult sockeye salmon were reared at the IDFG Eagle Fish Hatchery, Eagle, Idaho (five males, five females). The remaining 36 hatchery-produced adult sockeye salmon were reared at the NMFS Manchester Marine Laboratory, Manchester, Washington (we were unable to determine sex at time of release). An additional 118 anadromous adult sockeye salmon (hatchery origin) were released into Redfish Lake in September (79 males, 41 females). Redfish Lake Creek received 148 brood year 1998 PIT-tagged age-1 smolts (reared at Eagle Fish Hatchery) released directly into the stream.

Alturas Lake received 11,989 age-0 brood year 1999 presmolts released directly into the lake in July and October 2000. Of the 5,986 presmolts released in July, 2,917 were raised at Eagle Fish Hatchery, and 3,069 were reared at the IDFG Sawtooth Fish Hatchery. All 6,003 presmolts released in October were reared at Sawtooth Fish Hatchery. Twenty-five brood year 1997 hatchery-produced adult sockeye salmon, reared at Manchester Marine Laboratory, were released for volitional spawning directly into Alturas Lake on September 12 (we were unable to determine sex at time of release). Fifty-two anadromous adult sockeye salmon (hatchery origin) were released into Alturas Lake in September (36 males, 16 females).

Pettit Lake received 12,074 brood year 1999 age-0 presmolts released directly to the lake in July and October 2000. Of the 6,007 presmolts released in July, 2,915 were reared at Eagle Fish Hatchery, and 3,092 were reared at Sawtooth Fish Hatchery. All 6,067 presmolts released in October were reared at Sawtooth Fish Hatchery. Twenty-eight anadromous adult sockeye salmon (hatchery origin) were released into Pettit Lake in September for volitional spawning (20 males, eight females). A total of 65,200 eyed-eggs (44,440 Eagle Fish Hatchery and 20,760 Manchester Marine Laboratory) were planted in Pettit Lake in November.

METHODS

Kokanee Abundance, Density, and Biomass Estimation

To estimate kokanee abundance, density, and biomass in Sawtooth basin lakes, midwater trawling was conducted at night during the dark (new) phase of the moon in September. September was chosen so that spawning-age kokanee in Redfish and Alturas lakes would be in the tributaries and not sampled by the gear. In addition, juvenile kokanee that remain in basin lakes are tightly grouped during this period. Redfish, Pettit, and Alturas lakes were sampled September 25 to 29. Trawling was performed in a stepped-oblique fashion as described by Rieman (1992) and Kline (1994). A minimum of four trawl transects were conducted per lake. Redfish Lake was sampled on September 25 and 29, while Pettit and Alturas lake sampling were single night efforts. Total kokanee abundance, density, and biomass were estimated using the TRAWL.WK1 spreadsheet for Lotus 1-2-3 developed by Rieman (1992). Abundance estimates generated by this program are extrapolations of actual trawl catch data to the total area of the lake mid-depth in the observed *O. nerka* stratum. Density and biomass estimates generated by the program are extrapolations of catch data to the total

surface area. Whenever possible, we estimated abundance, density, and biomass by individual age class (assuming representation in the trawl).

Fork length (1 mm) and weight (0.1 g) were recorded for all trawl-captured kokanee. Sagittal otoliths and scales were removed from a subsample of kokanee and returned to the laboratory where they were aged by three readers to determine length ranges for age classification. Scales were pressed into acetate before aging. Tissue samples were collected and sent to the University of Idaho's Hagerman Fish Culture Experiment Station for genetic analysis. Stomachs were removed and preserved for diet analysis by SBT biologists.

Sport Fishery Investigations

Redfish Lake

Permit 1233 (NMFS) requires IDFG to monitor angler harvest of listed sockeye salmon in Redfish Lake. To comply with this requirement, a roving creel survey was conducted from May 27 through August 7, 2000 (kokanee harvest closes on August 7 to protect residual sockeye salmon). The census was stratified by 14 d intervals, broken into weekday and weekend day types, and morning (0600 to 1400) and evening (1400 to 2000) periods. Angler counts were conducted two weekdays and one weekend day during each week of the 14 d interval. On each angler count day, the number of boats and bank anglers were counted for each day period (morning and evening strata). Angler count dates were selected randomly, and count times were selected systematically. Angler interviews were conducted following the completion of each count. Anglers were asked how many fish they had harvested and/or released by species, how many hours they had fished, and the type of gear they used. Fin clips were taken from all creeled kokanee that were checked by creel survey personnel. Fin clips were stored in Lysis buffer solution and delivered to University of Idaho personnel for DNA analysis. Creel data were analyzed using the Creel Census System computer program developed by McArthur (1992) and used to estimate angler effort, catch rates, and harvest.

Alturas Lake

A roving creel survey of Alturas Lake was conducted from May 27 through September 2, 2000 following the same procedures described above for Redfish Lake. There is no kokanee fishing/harvest closure on Alturas Lake.

Out-migrant Monitoring and Evaluations

Redfish Lake Creek Trap

The out-migrant trap on Redfish Lake Creek (RLCTRP) is used to estimate numbers of wild/natural sockeye salmon smolts migrating from Redfish Lake and to monitor and estimate smolt out-migration from different hatchery release strategies. The trap is located 1.4 km downstream from the lake outlet at a permanent weir site and was operated from April 12 to June 14, 2000. The trap functions as a juvenile trap and with only minor modifications an adult trap (Bjornn et al. 1968, Craddock 1958). The weir contains nine bays, five of which are fitted with juvenile trap boxes. Personnel from IDFG checked the trap twice daily.

All sockeye salmon smolts captured at RLCTRP were anesthetized in buffered MS-222 (tricaine methanesulfonate), measured for fork length (1 mm) and weight (0.1g), and scanned for PIT tags. Hatchery-produced fish, identified by lack of an adipose fin, were scanned for PIT tags and released downstream of the weir one-half hour after sunset. Hatchery-produced sockeye salmon smolts captured at the trap originated primarily from an October 1999 release of 23,886 age-0 presmolts. Overwinter survival and out-migration between the two hatchery-produced groups was compared using chi-square analysis of PIT tag detections ($\alpha = 0.10$).

To estimate trapping efficiency, all wild/natural sockeye salmon smolts, determined by presence of an adipose fin, and up to 20 hatchery-produced sockeye salmon smolts per day were PIT tagged and released approximately 250 m upstream of the weir one-half hour after sunset. Flow-through live boxes with locking lids were used to hold fish until the evening release.

Trapping efficiencies were calculated for one time period for wild/natural sockeye salmon smolts and three time periods for hatchery-produced sockeye salmon smolts. Intervals were selected based on stream discharge similarities and number of marked out-migrants released upstream of the weir that were available for recapture. Out-migrant run size and 95% confidence intervals were estimated using maximum likelihood and profile likelihood estimators (Wu and Steinhorst 2000). Smolt out-migration estimates were generated separately for wild/natural and hatchery-produced sockeye salmon smolts.

Out-migrant trapping on Pettit Lake Creek and Alturas Lake Creek is the responsibility of the SBT, and results will be presented under a separate cover. The out-migrant trap on the Salmon River at the Sawtooth Fish Hatchery, located downstream from Pettit and Alturas lakes, was operated in 2000, but no attempt was made to develop an estimate of sockeye salmon smolt out-migration at this location.

Mainstem Snake and Columbia River Dams

Sockeye salmon smolt out-migration variables (travel time and date of arrival) were evaluated using PIT tag interrogation data collected at lower Snake and Columbia river dams with fish bypass and PIT tag detection facilities—Lower Granite (LGR), Little Goose (LGJ), Lower Monumental (LMN), and McNary (MCN) dams. The PIT tag interrogation data for mainstem Snake and Columbia river dams was retrieved from the Columbia River Basin PIT Tag Information System. Tagged to untagged ratios of smolts observed at Sawtooth basin trap locations were used to expand the number of PIT tag interrogations to derive a total out-migration estimate for presmolt release groups at LGR. Wild/natural and hatchery-produced smolt total out-migration was estimated using the known number of PIT tags released and the expanded number of PIT tags detected at LGR. Daily collection efficiency (DCE) (Sandford and Smith, in press) estimated for chinook salmon smolts was used to expand estimates of PIT tag interrogations for sockeye salmon smolts migrating past LGR. Daily collection efficiency takes into account the effect of spill on fish guidance efficiency. Median travel times to downstream dams with fish detection facilities were calculated for wild/natural and hatchery-produced sockeye salmon smolts. Distribution of arrival times for PIT-tagged fish at LGR were compared for wild/natural and hatchery-produced progeny (by release strategy) using two-sample Kolmogorov-Smirnov tests ($\alpha = 0.10$; Sokal and Rohlf 1981). Chi-square tests ($\alpha = 0.10$) paired by release strategy were used to compare cumulative unique PIT tag interrogations at LGR, LGJ, LMN, and MCN for similar release strategies between lakes (Zar 1984).

A priori power analysis for Chi-square tests was performed to determine PIT tag sample sizes needed for comparisons (Cohen 1988). Using a range of values for overwinter survival, out-migration, and cumulative unique interrogations at mainstem Snake and Columbia river dams and a desired power of 0.80 at $\alpha = 0.10$, it was estimated that a minimum of 850 fish in each release strategy needed to be PIT tagged.

Volitional Spawning Investigations/Natural Release Options

From September 5 to 7, 2000, 200 anadromous (hatchery origin) and 71 hatchery-produced adult sockeye salmon were released to Redfish, Pettit, and Alturas lakes for volitional spawning. Redfish Lake received 118 anadromous adults and 46 hatchery-produced adults. Alturas Lake received 52 anadromous adults and 25 hatchery-produced adults. Pettit Lake received 28 anadromous adults. The hatchery-produced fish were selected for release based on signs of sexual maturation (coloration, sexual dimorphism, and interpretation from physical handling). Prior to release, 19 male sockeye salmon were implanted with radio transmitters to facilitate the process of locating redds (11 anadromous hatchery origin, eight hatchery-produced adults). All hatchery-produced sockeye salmon were Floy-tagged before release. Radio-tagged sockeye salmon were distributed as follows: Redfish Lake received four anadromous (hatchery origin) males and four hatchery-produced males; Alturas Lake received three anadromous (hatchery origin) and four hatchery-produced males; Pettit Lake received four anadromous (hatchery origin) males.

Telemetry investigations of adult fish locations began on September 21 and continued weekly through October 30. Adult sockeye salmon were tracked weekly from date of release by boat using an Advanced Telemetry Systems receiver and three-element, handheld Yagi antenna. Fish location was determined by triangulation from at least two locations. Locations were marked on maps of each lake so that the position of transmitters could be monitored from week to week. Aerial surveys were conducted when most transmitters could no longer be located or had remained stationary for an extended period of time. Visual counts of suspected redds were made by boat and from a fixed-wing aircraft.

On November 30 and December 1, 65,200 eyed-eggs were placed into Pettit Lake in Eagle Hatchery egg boxes. Eggs were spawned and incubated to the eyed stage of development at the IDFG Eagle Fish Hatchery (44,400) and the NMFS Big Beef Creek Hatchery, Seabeck, Washington (20,760). Twenty-one boxes were planted with an average of 2,900 eyed-eggs per box. The location selected was the northeastern shore closest to the campground in the main body of the lake. Boxes were placed in water depths of 4 m to 7 m.

Egg boxes placed into Pettit Lake were recovered from May 7 to 16, 2001, and dead eggs and fry remaining in the boxes were counted. Data were recorded for 20 of 21 boxes recovered. The number of recruiting fry was estimated by taking the average number of eggs per box (2,900) and subtracting the number of dead eggs counted in each box. We assumed that eggs successfully hatched and that fry successfully emerged from egg boxes if they were not enumerated as dead during the retrieval process.

Parental Lineage Investigations

Differences between Sr/Ca ratios in otolith primordia are great enough to identify individual life history with respect to habitat location of the female parent during vitellogenesis. Otolith preparation followed procedures developed by Kalish (1990) and Rieman et al. (1993). Sample preparations are analyzed at Oregon State University (College of Oceanography, Corvallis, OR 97331-5503) following procedures outlined by Toole and Nielsen (1992).

Predator Investigations

Monitoring of bull trout spawners was initiated in 1995 to measure bull trout population response to no-harvest fishing regulations implemented by IDFG in 1994. In 2000, we surveyed index reaches on principal tributary streams of Redfish and Alturas lakes to enumerate bull trout spawners and redds. Surveys were conducted on Fishhook Creek (Redfish Lake drainage) and Alpine Creek (Alturas Lake drainage) on August 30 to 31 and September 14 to 15. Index sections were located using coordinates established with global positioning satellite (GPS) equipment. Visual observations of bull trout and bull trout redds were recorded.

RESULTS

Kokanee Abundance, Density, and Biomass Estimation

Redfish Lake

September trawl catch (six transects, Appendix A) included 11 wild/natural kokanee, zero hatchery-produced sockeye salmon, one redside shiner, and two sculpin. Abundance of kokanee was estimated at 10,267 fish (95% CI ± 5,675). Density and biomass were estimated at 16.7 fish/ha and 0.07 kg/ha (Table 4). Age-0 and -1 fish were captured in the trawl on Redfish Lake (Table 5).

Alturas Lake

September trawl catch on Alturas Lake (five transects, Appendix A) collected 285 wild/natural kokanee and no hatchery-produced sockeye salmon. We estimated kokanee abundance (± 95% confidence interval), density, and biomass at 125,463 (± 27,037) fish, 371 fish/ha, and 2.08 kg/ha respectively (Table 4). Age-0, -1, and -2 fish were captured in the trawl. Age-1 fish were most numerous and contributed 86% of the biomass (Table 5).

Pettit Lake

September trawl catch on Pettit Lake (four transects, Appendix A) collected 75 wild/natural kokanee, two hatchery-produced sockeye salmon, and one redside shiner. We estimated kokanee abundance (± 95% confidence interval), density, and biomass at 40,559 (± 11,717) fish, 253.5 fish/hectare, and 10.2 kg/ha respectively (Table 4). Only age-1 fish were captured in the trawl (Table 5).

Stanley Lake

Stanley Lake was not sampled in 2000.

Sport Fishery Investigation

Redfish Lake

In 2000, we contacted 63 angler parties (95 individual anglers) on Redfish Lake. Residents made up 76% of those interviewed. Most angling was done with lures (56%), followed by bait (35%), and only a small amount of fishing occurred with flies (9%). Total angler effort was estimated at 3,063 hours (95% CI ± 1,507) from May 24 through August 7. Boat anglers accounted for more effort than bank anglers (Table 6). The average fishing trip lasted 1.3 hours.

The season catch rate for all fish (harvested and released) was 0.38 fish/hour. Season catch rates (all fish) were higher for weekends (0.71 fish/hour) than for weekdays (0.25 fish/hour; Table 7). Kokanee catch rates (caught and released) averaged 0.11 fish/hour for weekdays and 0.03 fish/hour for weekends. Bull trout catch rates averaged 0.04 fish/hour for weekdays and 0.17 fish/hour for weekends (IDFG regulations prohibit harvesting bull trout). Other fish species accounted for catch rates of 0.21 fish/hour for the season (e.g., brook trout, redside shiners, mountain whitefish, northern pikeminnow).

The total number of fish caught (harvested and released) at Redfish Lake was estimated at 947 (95% CI ± 823; Table 8). The majority of fish (93%) caught were released. Kokanee accounted for 100% of all the fish harvested. The season total harvest was estimated at 67 fish (95% CI ± 110). Bull trout and kokanee comprised the majority of the fish released by anglers.

Sixteen fin clips were collected from angler-harvested kokanee (2000 season) and delivered to the University of Idaho's Hagerman Fish Culture Experiment Station for mitochondrial DNA haplotype analysis. Results of that analysis are pending.

Alturas Lake

In 2000, we contacted 210 angler parties (254 individual anglers) on Alturas Lake. Residents made up 65% of those interviewed. Most of the angling was done with bait (63%), followed by lures (32%), and only a small amount of fishing occurred with flies (5%). Total angler effort was estimated at 5,190 hours (95% CI ± 1,417) from May 27 through September 2 (Table 6). The majority of fishing was done by bank anglers (65%), fishing 3,386 hours (95% CI ±1,172). Boat anglers fished an estimated 1,804 hours (95% CI ±797).

The season catch rate for all fish (harvested and released) was 0.5 fish/hour (Table 7). Seasonal catch rates (all fish) were similar for weekdays (0.48 fish/hour) and weekends (0.53 fish/hour). Kokanee catch rates (harvested and released) averaged 0.06 fish/hour for the season. Bull trout catch rates averaged 0.02 fish/hour (IDFG regulations require no harvest of bull trout). Catch rates for rainbow trout were higher on weekends (0.38 fish/hour) than weekdays (0.14 fish/hour). Other fish species accounted for catch rates of less than 0.2 fish/hour for the season (e.g., brook trout, redside shiners, mountain whitefish, northern pikeminnow).

The total number of fish caught (harvested and released) at Alturas Lake was estimated at 2,797 fish (95% CI ± 1,026; Table 8). Rainbow trout accounted for 63% of harvested fish, while kokanee accounted for 29% of fish harvested. Other fish harvested included brook trout, redside shiners, and northern pikeminnow.

Out-migrant Monitoring and Evaluation

Redfish Lake Creek Trap

A total of 7,264 sockeye salmon smolts (302 wild/natural, 6,962 hatchery-produced) were trapped during the 2000 out-migration season (Figure 2). Fork-length of wild/natural and hatchery-produced sockeye salmon smolts captured averaged 119 mm (range 85 mm to 148 mm; Figure 3) and 112 mm (range 54 mm to 148 mm; Figure 4), respectively. We estimated that 50% of the wild/natural out-migrants were age-2 smolts. All hatchery-produced out-migrants were age-1.

To estimate total wild/natural sockeye salmon smolt out-migration, a single season efficiency interval (April 12 through May 21) was used (Table 9). The single interval was selected to reflect the relatively short period of emigration observed for wild/natural out-migrants. A total of 126 wild/natural smolts were handled in 2000. One hundred six of these fish were marked and released upstream of the weir to estimate trapping efficiency. Overall trapping efficiency for wild/natural out-migrants was estimated at 42%. Total wild/natural out-migration was estimated at 302 fish.

To estimate total hatchery-produced sockeye salmon smolt out-migration, the trapping season was divided into three periods of similar discharge (Table 9). Trapping intervals ran from April 12 to May 1, May 2 to May 20, and May 21 to June 14. A total of 2,378 hatchery-produced out-migrants were handled in 2000. Of the 2,378 hatchery-produced smolts handled, 493 were marked and released upstream of the weir to estimate trap efficiency. Trap efficiency was estimated at 19%, 46%, and 24% for the three trapping intervals. Total hatchery-produced smolt out-migration was estimated at 134, 3,349, and 3,479 for the three trapping intervals.

Mainstem Snake and Columbia River Dams

We estimated smolt out-migration success to LGR by release strategy using PIT tag interrogation data (Table 10). Estimates reflect numbers of smolts passing LGR (Appendix B, C). Redfish Lake had two groups of smolts for which estimates of out-migration were made: wild/natural and direct fall presmolt release. Numbers of wild/natural and direct fall release smolts passing LGR were estimated at 115 and 2,332. Alturas and Pettit lakes each had one group of smolts for which estimates of out-migration to LGR were made (resulting from direct fall presmolt releases). An estimated 3,062 hatchery-produced smolts from Alturas Lake and 1,593 hatchery-produced smolts from Pettit Lake were estimated to have passed LGR. No detections were recorded for the 148 smolts released below RLCTRP, and zero out-migration is assumed for this group.

Median travel times for smolts were recorded from Sawtooth basin trap sites to LGR, LGJ, LMN, and MCN (Table 11). Median travel times to LGR for Redfish Lake wild/natural and hatchery-produced sockeye salmon smolts were 10.9 days and 9.8 days, respectively.

Significant differences (Kolmogorov-Smirnov test, $p < 0.10$) in the distribution of arrival times at LGR were detected for all fall release hatchery-produced smolts (Redfish, Pettit, and Alturas lakes) against one another and the wild/natural smolts.

Chi-squared comparisons of PIT-tagged sockeye salmon smolts detected at mainstem Snake and Columbia River dams were performed to compare overwinter survival and out-migration of similar presmolt release strategies. Comparisons were made between Redfish, Pettit, and Alturas lakes smolts from the fall direct presmolts release groups. Alturas and Pettit lake smolts recorded significantly better detection rates than Redfish Lake direct fall release (Table 12). Pettit Lake presmolts recorded significantly better detection rates than Alturas Lake presmolts.

Volitional Spawning Investigations/Natural Release Options

Redfish Lake

Radio tracking of adults released to Redfish Lake (Appendix D) for volitional spawning began on September 21. Initially, the 164 adult sockeye salmon assembled into two groups. The first group was located at the north end of the lake (near Sockeye Beach). The second group was at the south end of the lake (opposite shore from the U.S. Forest Service transfer camp dock). Visual observations of schooling adults indicated that both hatchery-produced and anadromous (hatchery-origin) adults were schooling together in both locations.

We estimated that 20 to 29 possible redds were constructed in Redfish Lake in 2000. We observed 10 to 15 areas of excavation (possible redds) at the south end of Redfish Lake and 10 to 14 areas of excavation on Sockeye Beach. The first area of excavation was sighted at the south end of the lake on October 4. Observations made by fixed-wing aircraft on November 7 confirmed the location and number of excavations at the south end of the lake. Observation of suspected redds located on Sockeye Beach was unsuccessful from the air. No additional areas of excavation were identified in other areas of the lake during the flight.

Four of the eight radio transmitters implanted into adult sockeye salmon were recovered during tracking events. Two radio transmitters were recovered (one from an anadromous adult, one from a hatchery-produced adult) without carcasses on the shore of Sockeye Beach. One radio transmitter (from a hatchery-produced adult) was recovered near the mouth of Fishhook Creek (no carcass was associated with this transmitter). One radio transmitter (from an anadromous adult) was recovered at the south end of the lake associated with a carcass that showed signs that it had spawned prior to death.

Little Redfish Lake

We located one radio-tagged anadromous (hatchery-origin) sockeye salmon during mobile tracking activities on Little Redfish Lake. This fish had been tagged at Lower Granite Dam in conjunction with a University of Idaho migration study, captured at Sawtooth Fish Hatchery, and released to Redfish Lake. Sometime following release, this fish migrated out of Redfish Lake to Little Redfish Lake. The fixed-wing flight on November 7 located three areas of excavation (possible redds) on the east shore of Little Redfish Lake.

Alturas Lake

The 77 adult sockeye salmon released to Alturas Lake (Appendix D) in September assembled in two primary groups following release. The first group was located near the inlet end of the lake. The second was located between the boat ramp and the outlet end of the lake. Although initially in two groups, all radio-tagged sockeye salmon had congregated near the beach at the inlet end of the lake by October 3. On October 12, one radio-tagged sockeye salmon was located on the northwest shore of the lake. For the remainder of the tracking period, radio-tagged sockeye salmon displayed strong site fidelity to inlet or northwest shoreline locations.

We estimated that 14 to 19 possible redds were constructed in Alturas Lake in 2000. An estimated 9 to 14 areas of excavation where identified along the inlet beach at the south end Alturas Lake. Five additional areas of excavation were identified on the northwest shore of Alturas Lake between the boat ramp and outlet. The fixed-wing survey conducted on November 7 failed to locate any additional areas of excavation in Alturas Lake or Perkins Lake (downstream of Alturas Lake).

Three of the seven radio transmitters implanted into adult sockeye salmon were recovered during our tracking events. One radio transmitter (from an anadromous adult) was recovered at the south end of the lake near the inlet beach. This transmitter was associated with a carcass that appeared to have spawned prior to death. One radio transmitter (from an anadromous adult) was recovered from the lakeshore near the outlet of Alturas Lake. No carcass was associated with this transmitter. One radio transmitter (from a hatchery-produced adult) was recovered on a sand bar approximately 80 m upstream of Alturas Lake in Alturas Lake Creek. No carcass was associated with this transmitter.

Pettit Lake

Although we located the radio-tagged sockeye salmon released to Pettit Lake (Appendix D) in September several times during our tracking events, we failed to locate any potential redds. Radio-tagged adult sockeye salmon were located in the following areas: the northwest corner of the lake, the south shore of the lake, and the west shore of the lake. On October 12, three of the four adults implanted with transmitters were located near the northwest corner of the lake (inlet end). Radio-tagged fish remained in this area for the next three weeks until we ceased tracking operations. Only one radio transmitter (anadromous) was recovered from Pettit Lake. This transmitter was associated with a partial carcass recovered on the northwest shoreline of the lake. Due to the condition of the carcass, we were unable to assess whether this fish had spawned.

Pettit Lake received the only sockeye salmon eyed-egg plant conducted in 2000. Survival of eyed-eggs ranged from 39% to 99% between egg boxes and averaged 75% (Table 13). Based on this estimate the eyed-egg plant could have contributed 45,000 fry to the lake. During egg box retrieval we also noted the presence of live fry in 35% of the egg boxes and dead fry in 70% of the boxes (Table 13). Live fry were carefully removed from the boxes and released to the lake.

Parental Lineage Investigations

Otoliths from unmarked 2000 anadromous adult sockeye salmon will be prepared for analysis and sent to Oregon State University.

Predator Investigations

Fishhook Creek

We observed 16 adult bull trout and 12 completed redds on August 31. Water temperature at 1053 hours was 8.5°C. On our second survey, September 14, we observed two adult bull trout and 18 completed redds. Water temperature was 8.0°C at 1020 hours during the second survey.

Alpine Creek

We observed 18 adult bull trout and six completed redds during the August 30 survey. Water temperature on August 30 was 10.5°C at 1300 hours. On September 15 we observed five adult bull trout and nine completed redds. Water temperature was 9.0°C at 1220 hours during the second survey.

DISCUSSION

Abundance, Density and Biomass Estimation

Understanding the dynamics of the kokanee populations in the Sawtooth basin lakes is a vital part of efforts to restore sockeye salmon to thesis lakes. Knowledge of kokanee abundance coupled with lake limnology data (collected by the Shoshone Bannock Tribal Fisheries) is necessary for making responsible decisions regarding supplementation of sockeye salmon juveniles from the captive broodstock program.

Redfish Lake

Although Redfish Lake has the largest surface area of the three lakes studied, kokanee spawning habitat is limited to a short reach of Fishhook Creek. Because of the spawning habitat limitation, the kokanee population has been relatively stable from 1990 to 1999 and has been maintained at relatively moderate densities compared to the other lakes in the basin. Year to year population abundance has varied less than 40%. Despite the historically stable nature of this system, abundance decreased by 75% in 2000 to its lowest recorded value of 10,268. The unprecedented decrease in kokanee abundance will provide the opportunity to evaluate the response of zooplankton to the lower predation rate but will also give us an opportunity to monitor the resiliency of the Redfish Lake system to recover kokanee following a crash.

Alturas Lake

Abundance of kokanee in Alturas Lake has been highly variable since monitoring began. We believe that abundant spawning habitat for kokanee in Alturas Lake Creek contributes to the highly variable kokanee abundance observed (over 120,000 fish in 1990 to less than 6,000 fish in 1994). The 2000 estimate of abundance (125,462) is one of the highest values recorded, more than doubling the estimate from 1999.

The large increase in the abundance of kokanee in 2000 will provide an opportunity to determine if lake fertilization can dampen the effects of higher grazing pressure from a large zooplanktivorous population. The last large increase in kokanee population was followed two years later by a crash in kokanee numbers. Zooplankton monitoring was initiated during the years when the crash was building (also years prior to fertilization). Subsequent monitoring indicated that the zooplankton community prior to the severe decline in kokanee was characterized by lower total biomass and a scarcity in preferable kokanee forage species such as *Daphnia spp*. The zooplankton community prior to the crash suggests that high densities of kokanee may be controlling zooplankton numbers. If lake fertilization can dampen the effects of high grazing pressure, then in the coming years we should not see the low total zooplankton biomass and scarcity of *Daphnia spp*. seen previously.

Pettit Lake

Since monitoring began in 1992, Pettit Lake has exhibited the greatest relative fluctuation in kokanee numbers (maximum to minimum range) of the three lakes studied. Kokanee abundance increased from 1992 (3,009) to 1996 (71,654), then declined by 70% in 1997. The population has increased steadily since 1997 reaching the third highest population on record for Pettit Lake (40,559).

We suspect that the variation in estimated abundance reflects a combination of conditions related to spawning habitat availability (large amount of shoal spawning areas) and corresponding compensatory responses associated with unchecked population growth. Zooplankton data collected by SBT biologists appears to support this hypothesis (SBSTOC minutes, November 25, 2001). As kokanee abundance increases to a threshold level, a corresponding decrease in zooplankton biomass follows. Zooplankton species shifts accompany the decrease in biomass, with preferable species for kokanee foraging (*Daphnia spp.*) becoming scarce to absent. After a recovery period (kokanee population decline), zooplankton biomass stabilizes and begins to increase. This stabilization is accompanied by an increase in desirable zooplankton, which results in an increase in kokanee abundance.

Sport Fishery Investigation

Redfish Lake

The kokanee fishery on Redfish Lake was closed in 1993 due to the presence of ESA-listed residual sockeye salmon and was reopened in 1995 (NMFS Permit 1233). The fishery was reopened based on the recommendation of the SBSTOC to help reduce kokanee competition with sockeye salmon by removing spawning age kokanee through angler harvest. Kokanee become more susceptible to fishing gear and harvest by anglers as they increase in

age and length. We assume that kokanee anglers on Redfish Lake primarily remove adults of spawning age from the population. Removal of spawning-age kokanee helps to reduce total egg deposition, potentially decreasing kokanee recruitment and competition with sockeye salmon in future years. Kokanee escapement to Fishhook Creek during the 2000 spawning season was estimated at 60 fish (SBT data). In 2000, anglers harvested an estimated 67 kokanee from Redfish Lake. If we assume the kokanee that were creeled were spawning age fish, then the sport fishery reduced kokanee spawning numbers by approximately 53%.

The direct impact of the kokanee fishery on residual sockeye salmon (through incidental harvest) is addressed yearly using genetic analysis of tissue samples collected from creeled kokanee. Of the 115 fin clips collected from creeled kokanee since 1996, only one (collected in 1996) was found to exhibit a mitochondrial DNA haplotype unique to residual sockeye salmon. The 2001 estimate of incidental take assumes that the proportion of residual sockeye salmon to kokanee recruiting to the sport fishery (age-2+ and older) is 0.8% (one out of 115 genetic samples analyzed). If we apply 0.8% to the total number of kokanee harvested during the 2001 fishery (67), we arrive at our estimated incidental take of <1 ESU fish. Permit 1233 allows for an incidental take of 34 naturally-produced (unmarked) Snake River sockeye salmon associated with the kokanee fishery on Redfish Lake.

In addition to the benefits of reducing competition, Redfish Lake also provides an important recreational fishery. Anglers fished over 3,000 hours in 2000. Angler effort was slightly lower in 2000 than in 1999, and we attribute this reduction in angler effort to low numbers of adult kokanee present in the system, as evidenced by low escapement of spawning kokanee to Fishhook Creek. There was also a decrease in effort by nonresident anglers who accounted for 24% of the effort in 2000, down from 41% in 1999.

Alturas Lake

This was the first year that the sport fishery on Alturas Lake has been surveyed in association with this project. The majority of the anglers fishing Alturas Lake were residents (65%); however, nonresidents made up a larger percent of anglers at Alturas Lake than at Redfish Lake. Angler effort on Alturas Lake was higher than on Redfish Lake by over 2,000 hours. We believe that the increased amount of fishing by bank anglers on Alturas Lake was the result of stocking catchable rainbow trout (8,165) compared to Redfish Lake were no rainbow trout stocking occurs. Anglers harvested an estimated 890 rainbow trout for a return-to-creel rate of 11%.

Out-migration Monitoring and Evaluation

Monitoring overwinter survival and out-migration of sockeye salmon smolts plays an important role in restoration efforts. Trapping conducted on the lake outlet streams provides us an opportunity to gain valuable information on timing of out-migration and smolt sizes. Out-migrant monitoring provides an opportunity to monitor natural production of sockeye salmon in the lake and evaluate the success of different release strategies. This information allows us to make informed decisions regarding the disposition of future captive broodstock progeny.

Redfish Lake Creek Trap

Beginning in 1998 the majority of the presmolts destined for release back to Sawtooth Basin lakes have been reared at Sawtooth Fish Hatchery. The 2000 out-migration year is the second opportunity to evaluate a group reared at Sawtooth and released to the lakes to overwinter and out-migrate. Overwinter survival of presmolts reared at Sawtooth and released to Redfish Lake in the fall has been 33% to 44% (1998 and 1999 releases) compared to 14% to 17% (1996 and 1997 releases). This improvement appears to be related to early rearing differences, but further studies will need to be directed to determine if this is a hatchery effect or a result of differing lake productivities between years.

We estimated that 50% of the smolts passing RLCTRP in 2000 were age-2. Historical information from Bjornn et al. (1968) noted that for six out of the 11 years, out-migration was dominated by age-1 smolts, but the presence of age-2 smolts was well documented, contributing 2% to 77% to the total out-migration. Age-2 out-migrants are common in many other sockeye lakes, although the reasons for the additional freshwater residence time are unclear (Groot and Margolis 1991).

In 1998, there were no natural releases from the captive broodstock program (eyed-eggs or mature adults) that would have produced unmarked age-1 smolts in 2000. Therefore, the 150 unmarked age-1 smolts should be from residual spawning that occurred in 1998. Wild/natural smolt production increased drastically in 1998 and 1999 following a 300 smolt out-migration that occurred in 1997. This increase was attributed to eyed-egg and mature adult releases. The decline in wild/natural production in absence of eyed-egg or mature adult releases provides further evidence that the increases observed in 1998 and 1999 were the result of one of the natural release options.

Mainstem Snake and Columbia River Dams

We use estimates of survival to LGR as another method of evaluating success of progeny released from the captive broodstock program. This method should be continued, but the results should be viewed carefully in making future release decisions due to the multitude of factors that can affect detections of PIT-tagged sockeye salmon. Currently there are no daily collection efficiencies estimated for sockeye salmon smolts at Lower Granite Dam; therefore, we use estimates for chinook salmon smolts. In addition, while this is the best available method, we must use caution and not overemphasize these results. Date of smolt arrival can also affect the probability of a PIT-tagged fish being detected. During the 2000 out-migration year, PIT-tagged sockeye salmon smolts were detected between May 1 and July 9. Both flow and percent of flow as spill during the period of sockeye salmon smolt out-migration varies widely and collection efficiency varies accordingly. This results in a greater chance for a PIT-tagged fish being detected in July (little or no spill) than in June (with 25% to 49% spill). Daily collection efficiencies attempt to correct for the change in probability of detection.

Cumulative unique PIT tag detections is another measure of smolt survival from release to downstream dams. Fish detected at facilities downstream of LGR dam had to successfully pass LGR first, so cumulative unique detections represent a minimum actual survival to LGR. For the 2000 out-migration year, smolts from the Pettit Lake fall direct presmolt release recorded more detections than any of the other releases. This is in contrast to the 1999 fall direct presmolt release when the Pettit and Alturas groups performed similarly. The 1998 and

1999 release groups were all reared at Sawtooth Fish Hatchery so rearing location was not a variable that could have affected out-migration. It is quite probable that overwintering conditions in the lakes will affect a smolt's "fitness" and ability to survive out-migration. Currently we are working with the University of Idaho to determine if total body lipid content of smolts captured at Sawtooth Basin trap sites can be correlated with out-migration success.

Volitional Spawning and Natural Release Options

The year 2000 saw the largest return of adult sockeye salmon to the Sawtooth Basin since the early 1970s. Of the returning adults 96% were directly identified to be the result of releases from the captive broodstock program. The remaining 4% of unmarked adults all returned to Redfish Lake and were likely the result of natural release options due to the low number of unmarked smolts in the absence of the natural release options and low numbers of residual sockeye salmon seen on the spawning grounds.

Several release strategies were represented in the adults that returned in 2000. As mentioned above, 10 unmarked adults returned which were attributed to either the eyed-egg plants or mature adults released for volitional spawning. The largest returning group of adults (190) was a smolt release group reared at ODFW's Bonneville fish hatchery and released to the Upper Salmon River and Redfish Lake Creek in 1998. Forty-three of the returning adults were adipose fin-clipped, identifying them as having been reared at Sawtooth Fish Hatchery and released as either presmolts or smolts. Approximately 14 additional adult sockeye salmon were located in the Salmon River between the adult fish weir at Sawtooth Fish Hatchery and Buckhorn Bridge (downstream of the adult weir). These fish were observed by snorkeling but were never trapped.

Most of the 2000 anadromous (hatchery origin) sockeye salmon that returned to the Sawtooth basin in 2000 were released to the lakes to spawn naturally. The release of anadromous sockeye salmon to Pettit Lake is the first occurrence of adult sockeye salmon in this lake since the barrier was installed on the outlet in 1965. The anadromous release of sockeye salmon to Alturas Lake represents the first time since the early 1980s that anadromous sockeye salmon have spawned in the lake. The remaining 43 anadromous sockeye salmon were returned to Eagle Fish Hatchery and incorporated into the captive broodstock program.

Adult sockeye salmon released to Redfish Lake in 2000 spawned in historic sockeye salmon spawning areas of Sockeye Beach and the south end of the lake. Hatchery-produced adult sockeye salmon were observed on the same spawning areas as anadromous fish. Although behavioral data was not collected, anecdotal observations indicated that hatchery-produced captive sockeye salmon were interacting with their anadromous counterparts.

Historical accounts indicated that sockeye salmon spawning in Alturas Lake was confined entirely to Alturas Lake Creek. Anadromous sockeye salmon released to Alturas Lake in 2000 were derived from Redfish Lake stock sockeye salmon (beach spawning stock). Intensive monitoring indicated that all sockeye salmon spawning took place on beach areas of the lake. Given that none of the fish released to the lake had the opportunity to imprint to the creek, it is not surprising that these fish chose beach-spawning areas. Similar behavior has been observed in sockeye salmon in Wenatchee Lake, Washington. The wild population of Wenatchee Lake sockeye salmon are primarily tributary spawners. Hatchery supplementation sockeye salmon that are reared in in-lake net pens to smolt age, with no imprinting to tributary streams, are rarely observed on the tributary spawning grounds (Mike Tonseth, Washington

Department of Fish and Wildlife, personal communication). Hatchery-produced adult sockeye salmon released to Alturas Lake were also seen interacting with their anadromous counterparts, similar to behavior seen in Redfish Lake.

Little information exists on historic sockeye salmon spawning areas in Pettit Lake. The tributary stream to Pettit Lake provides little to no spawning habitat for sockeye salmon, which indicates that spawning was beach oriented. Although spawning activity was not observed in Pettit Lake, fish did assemble near the northwest corner of the lake in a deep-water area. Based on the behavior of the anadromous sockeye salmon released to the other lakes, we believe that spawning did occur, but we were unable to verify the activity due to the deep-water area where radio transmitters were concentrated.

Predator Investigations

Bull trout spawner investigations were initiated in 1995 to track population response to no-harvest fishing regulations implemented by IDFG in 1994. Trend data of this nature have been successfully used to measure population response to fishing regulation changes implemented for adfluvial bull trout populations in Oregon and British Columbia (Ratliff 1992; Stelfox and Egan 1995).

Final index sections were established on Fishhook and Alpine creeks in 1998. Information collected in 2000 represents the third year data were collected in the same index reaches. We observed similar numbers of adult bull trout in both tributaries surveyed, but the final redd count located twice as many redds in the Fishhook Creek trend section. Since monitoring was initiated we have located more redds in Fishhook Creek than Alpine Creek. We have also seen a steady increase in the number of redds since monitoring began (Figure 6). The increase in numbers of redds may indicate an increase in the number of spawning age bull trout following the closure to harvest in 1994.

This effort represents the only attempt to monitor bull trout populations in the upper Salmon River drainage. Tracking changes in bull trout spawner abundance will hopefully facilitate a more thorough interpretation of potentially limiting nursery habitat variables and provide insight for prioritizing future research needs.

Table 1. Physical and morphometric characteristics of five study lakes located in the Sawtooth basin (Sawtooth Valley National Recreation Area), Idaho.

Surface Area (ha)	Elevation (m)	Volume ($m^3 \times 10^6$)	Mean Depth (m)	Maximum Depth (m)	Drainage Area (km^2)
Redfish Lake					
615	1,996	269.9	44	91	108.1
Alturas Lake					
338	2,138	108.2	32	53	75.7
Pettit Lake					
160	2,132	45	28	52	27.4
Stanley Lake					
81	1,985	10.4	13	26	39.4
Yellowbelly Lake					
73	2,157	10.3	14	26	30.4

Table 2. Hatchery-produced sockeye salmon released to Sawtooth basin waters in 1999. Adults and eyed-eggs were reared at the Eagle Fish Hatchery (IDFG). Smolts and presmolts were reared at the Sawtooth Fish Hatchery (IDFG).

Strategy	Brood Year	Release Date	Number Released	Number PIT tagged	Date Tagged	Weight at Tagging (g)	Weight at Release (g)
Upper Salmon River							
Smolt	1997	May 4	4,859	399	Apr 1	22.4	25.4
Redfish Lake Creek							
Smolt	1997	May 5	4,859	400	Apr 1	22.4	25.4
Redfish Lake							
Adult	1996	Sep 15	18	18	1997	NA	2,600.0
Adult (anadromous)	1996	Sep 15	3	0	NA	NA	NA
Fall presmolt direct	1998	Oct 13	23,886	1,560	Oct 5-6	9.7	9.7
Pettit Lake							
Fall presmolt direct	1998	Oct 13	3,430	2,009	Oct 5-6	10.4	10.4
Eyed-egg	1999	Nov 18	20,311	NA	NA	NA	NA
Alturas Lake							
Fall presmolt direct	1998	Oct 13	12,955	1,559	Oct 5-6	10.8	10.8

Table 3. Sockeye salmon releases made to Sawtooth basin waters in 2000.

Release Location	Strategy (Brood Year)	Release Date	Number Released	Number PIT Tagged[a]	Release Weight (g)	Rearing Location
Redfish Lake Creek smolt						
(Downstream of weir)	(1998)	05/09/00	148	148	2 58.8	Eagle Fish Hatchery
Redfish Lake presmolt						
(Direct lake)	(1999)	10/11/00	48,051	—	10.8	Sawtooth Fish Hatchery
Redfish Lake adult						
(Boat ramp)	(1997)	09/05/00	36	—	985.0	Manchester Marine Laboratory
	(1997)	09/06/00	10	—	3,300.0	Eagle Fish Hatchery
	(1996)	09/06,07/00	118	—	1,500.0	Anadromous return
Alturas Lake presmolt						
(Direct lake)	(1999)	07/31/00	2,917	—	8.5	Eagle Fish Hatchery
	(1999)	07/31/00	3,069	—	3.0	Sawtooth Fish Hatchery
	(1999)	10/11/00	6,003	—	12.8	Sawtooth Fish Hatchery
Alturas Lake adult						
(Boat ramp)	(1997)	09/05/00	25	—	994.0	Manchester Marine Laboratory
	(1996)	09/07/00	52	—	1,500.0	Anadromous return
Pettit Lake presmolt						
	(1999)	07/31/00	2,915	—	8.5	Eagle Fish Hatchery
	(1999)	07/31/00	3,092	—	3.0	Sawtooth Fish Hatchery
	(1999)	10/11/00	6,067	—	13.9	Sawtooth Fish Hatchery
Pettit Lake adult						
	(1996)	09/07/00	28	—	1500.0	Anadromous return
Pettit Lake eyed-egg						
	(2000)	11/29,30/00	20,760	—	—	Manchester Marine Laboratory
	(2000)	11/29,30/00	44,440			Eagle Fish Hatchery

[a] Only the smolts for the 2000 release year were PIT tagged

Table 4. Estimated kokanee population, density (fish/ha), and biomass (kg/ha) in four Stanley basin lakes, 1990 to 2000.

Date	Population (95% CI)		Density (fish/ha)	Biomass (kg/ha)
Redfish Lake (615 surface hectares)				
9/25/00	10,267	(5,675)	16.7	<0.1
9/08/99	42,916	(13,177)	69.7	0.9
9/21/98	31,486	(11,349)	51.2	1.8
9/02/97	55,762	(13,961)	90.7	2.5
9/10/96	56,213	(28,102)	91.4	2.8
9/26/95	61,646	(27,639)	100.2	4.4
9/06/94	51,529	(33,179)	83.8	1.4
9/17/93	49,628	—*	80.7	1.6
9/29/92	39,481	(10,767)	64.2	1.0
8/20/90	24,431	(11,000)	39.7	0.8
Alturas Lake (338 surface hectares)				
9/25/00	125,463	(27,037)	371.0	2.1
9/09/99	56,675	(43,536)	167.7	0.4
9/23/98	65,468	(34,284)	193.7	1.4
9/04/97	9,761	(4,664)	28.9	2.1
9/12/96	13,012	(3,860)	38.5	1.4
9/25/95	23,061	(9,182)	68.2	1.7
9/07/94	5,785	(6,919)	17.1	0.4
9/17/93	49,037	(13,175)	145.1	2.6
9/25/92	47,237	(61,868)	139.8	2.4
9/08/91	125,045	(30,708)	370.0	3.9
8/19/90	126,644	(31,611)	374.7	3.3
Pettit Lake (160 surface hectares)				
9/28/00	40,559	(11,717)	253.5	10.2
9/10/99	31,422	(21,280)	196.4	6.3
9/22/98	27,654	(8,764)	172.8	9.7
9/03/97	21,730	(11,262)	135.8	5.1
9/11/96	71,654	(9,658)	447.8	15.3
9/24/95	59,002	(15,735)	368.8	14.7
9/08/94	14,743	(3,683)	92.1	3.1
9/18/93	10,511	(3,696)	65.7	0.8
9/27/92	3,009	(2.131)	18.8	2.5
Stanley Lake (81 surface hectares)				
9/24/98	14,936	(7,391)	184.4	5.0
9/27/95	1,021	(702)	12.6	0.2
9/07/94	2,694	(913)	33.3	0.4
9/16/93	1,325	(792)	16.4	0.5
8/28/92	2,117	(1,592)	26.1	0.2

*Confidence limits not calculated—single transect estimate.

Table 5. Estimated 2000 kokanee abundance, density (fish/ha), and biomass (kg/ha) by age-class in Sawtooth basin lakes.

	Age-0	Age-1	Age-2	Age-3	Total
Redfish Lake (615 surface ha)					
# Captured	8	3	0	0	11
Length range (mm)	0-79	80-120	—	—	—
Mean length (mm)	62.2	98.7	—	—	—
Mean weight (g)	2.4	10.5	—	—	—
Abundance	7,688	2,579	—	—	10,267
95% CI High	12,872	4,888	—	—	15,942
95% CI Low	2,504	270	—	—	4,592
Density (fish/ha)	13	4	—	—	17
Biomass (kg/ha)	0.03	0.04	—	—	<0.1
Alturas Lake (338 surface ha)					
# Captured	120	160	5	0	285
Length range (mm)	0-80	81-155	>156	—	—
Mean length (mm)	59.4	106.3	159.8	—	—
Mean weight (g)	2.1	12.2	36.7	—	—
Abundance	52,826	71,316	1,321	—	125,463
95% CI High	71,242	91,081	2,399	—	152,500
95% CI Low	34,411	51,550	242	—	98,426
Density (fish/ha)	156	211	4	—	371
Biomass (kg/ha)	0.2	1.8	0.1	—	2.1
Pettit Lake (160 surface ha)					
# Captured	0	75	0	0	75
Length range (mm)	—	140-190	—	—	—
Mean length (mm)	—	162.2	—	—	—
Mean weight (g)	—	40.6	—	—	—
Abundance	—	40,559	—	—	40,559
95% CI High	—	45,750	—	—	45,750
95% CI Low	—	35,369	—	—	35,369
Density (fish/ha)	—	253	—	—	253
Biomass (kg/ha)	—	10.3	—	—	10.3

Table 6. Estimated angler effort for the 2000 fishing season on Redfish and Alturas lakes.

	Boat	Bank	Total
Redfish Lake			
Hours fished	1,783	1,280	3,063
± 95% CI	1,214	893	1,507
Alturas Lake			
Hours fished	1,804	3,386	5,190
± 95% CI	797	1,172	1,417

Table 7. Catch rates (fish/hour) for the 2000 fishing season on Redfish and Alturas lakes categorized by day type and species.

	Kokanee			Bull Trout	Rainbow Trout		Other		All Fish		
Day Code	Kept	Released	Combined	Released	Kept	Released	Kept	Released	Kept	Released	Combined
Redfish Lake											
Weekday	0.03	0.08	0.11	0.04	0.00	0.00	0.00	0.09	0.03	0.22	0.25
Weekend day	0.01	0.02	0.03	0.17	0.00	0.01	0.00	0.51	0.01	0.70	0.71
Season average	0.02	0.06	0.08	0.08	0.00	0.00	0.00	0.21	0.02	0.36	0.38
Alturas Lake											
Weekday	0.03	0.03	0.06	0.01	0.11	0.03	0.00	0.26	0.15	0.34	0.48
Weekend day	0.04	0.01	0.05	0.03	0.33	0.05	0.04	0.04	0.42	0.12	0.53
Season average	0.03	0.03	0.06	0.02	0.17	0.04	0.01	0.19	0.22	0.27	0.50

Table 8. Estimated number of fish harvested and released on Redfish and Alturas lakes during the 2000 fishing season.

	Harvested				All fish	
	Kokanee	Rainbow trout	Other	Released	Harvested	Combined
Redfish Lake						
Number of fish	67	0	0	880	67	947
95% CI	110	0	0	414	110	823
Alturas Lake						
Number of fish	407	890	109	1,379	1,420	2,797
95% CI	280	447	119	441	644	1,026

Table 9. Out-migration data for sockeye salmon smolts captured at the Redfish Lake Creek Trap (by efficiency periods) from April 12 to June 14, 2000.

Wild/Natural Smolts		
Dates	**4-12 to 5-21**	**Total**
Trap efficiency	0.42	—
Marked	106	—
Recaptured	44	—
Total handled	126	—
Estimated total	302	302
Upper bound	400	400
Lower bound	237	237

Hatchery-Produced Smolts				
Dates	**4-12 to 5-1**	**5-2 to 5-20**	**5-21 to 6-14**	**Total**
Trap efficiency	0.19	0.46	0.24	—
Marked	22	145	326	—
Recaptured	4	66	77	—
Total handled	25	1,530	823	—
Estimated total	134	3,349	3,479	6,962
Upper bound	425	4,075	4,310	8,020
Lower bound	60	2,832	2,864	6,114

Table 10. Summary of 2000 sockeye salmon smolt out-migration information (by release strategy) at trap locations and at Lower Granite Dam (LGR).

Initial No. Released	Initial No. PIT Tagged	Estimated No. of Out-Migrants at Trap Sites	No. of PIT-Tag Interrogations at LGR	% Interrogated	Estimated No. of PIT-Tagged Smolts at LGR	Estimated No. of Total Smolts at LGR	Survival from Trap to LGR	Survival from Release to LGR
Redfish Lake—Wild/natural smolts								
302	107	302	14	13.1%	41	115	38.1%	—
Redfish Lake—Direct Lake presmolt (fall)								
23,866	1,557	6,962	42	2.7%	152	2,332	33.5%	9.8%
Alturas Lake—Direct Lake presmolt (fall)								
12,955	1,554	4,387	117	7.5%	367	3,062	69.8%	23.6%
Pettit Lake—Direct Lake presmolt (fall)								
3,430	2,004	—	269	13.4%	934	1,593	—	46.4%
Redfish Lake Creek—Smolt								
148	148	148	0	0.0%	0	0	0.0%	0.0%

Table 11. Travel times of PIT-tagged sockeye salmon smolts recorded from outlet creek traps to mainstem Snake and Columbia river dams: Lower Granite (LGR), Little Goose (LGJ), Lower Monumental (LMN), and McNary (MCN) during 2000.

Release Strategy	Travel Time (Days)	LGR	LGJ	LMN	MCN
Redfish Lake					
Wild/natural	Median	10.9	12.5	16.4	—
	N	14	4	5	0
Fall direct presmolt	Median	9.8	15.7	15.8	15.8
	N	31	31	17	24
Alturas Lake					
Fall direct presmolt	Median	11	13	13	17.3
	N	22	16	5	4
Pettit Lake					
Summer direct presmolt	Median	—	—	—	—
	N	—	—	—	—
Redfish Lake Creek					
Smolt	Median	—	—	—	—
	N	0	0	0	0

Table 12. Comparison of overwinter survival and out-migration of sockeye salmon smolts to the mainstem Snake and Columbia river dams with juvenile detection systems (Lower Granite, Little Goose, Lower Monumental, and McNary) during 2000.

Location	Release Strategy	PIT Tags at Release	Cumulative Unique Detections	% PIT Tags to Dams	*P* Value
Redfish	Direct presmolt	1,557	96	6	<0.001
Pettit	Direct presmolt	2,009	604	30	
Redfish	Direct presmolt	1,557	96	6	<0.001
Alturas	Direct presmolt	1,559	276	18	
Pettit	Direct presmolt	2,009	604	30	<0.001
Alturas	Direct presmolt	1,559	276	18	

Table 13. Estimated mortality of eyed eggs placed in Pettit Lake in 2000 and numbers of live and dead fry remaining in egg boxes at retrieval. Each box contained an average of 2,900 eggs.

Box	Dead Eggs	Dead Fry	Live Fry	Percent Dead Eggs at Removal
1	1,034	200	0	36
2	192	200	0	7
3	34	50	0	1
4	509	50	0	18
5	1,072	50	0	37
6	787	75	5	27
7	1,006	10	1	35
8	674	10	0	23
9	106	10	0	4
10	872	10	3	30
11	333	10	7	12
12	873	0	0	30
13	38	0	0	1
14	819	4	4	28
15	1,453	0	0	50
16	804	0	0	28
17	1,760	0	0	61
18	1,236	0	0	43
19	491	138	58	17
20	297	67	251	10
Total	**14,390**	**884**	**329**	**25**

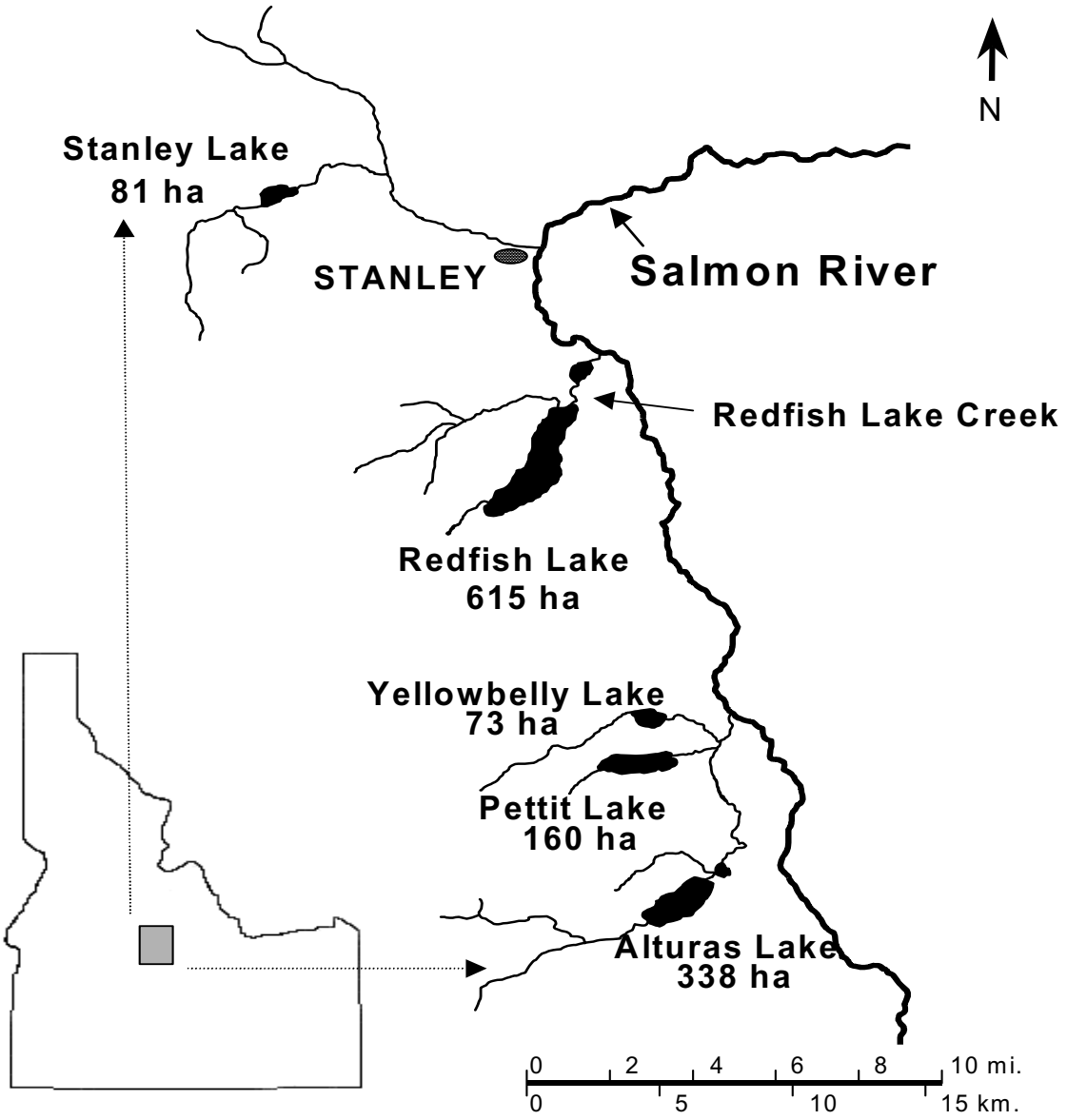

Figure 1. Location of Sawtooth basin in Idaho.

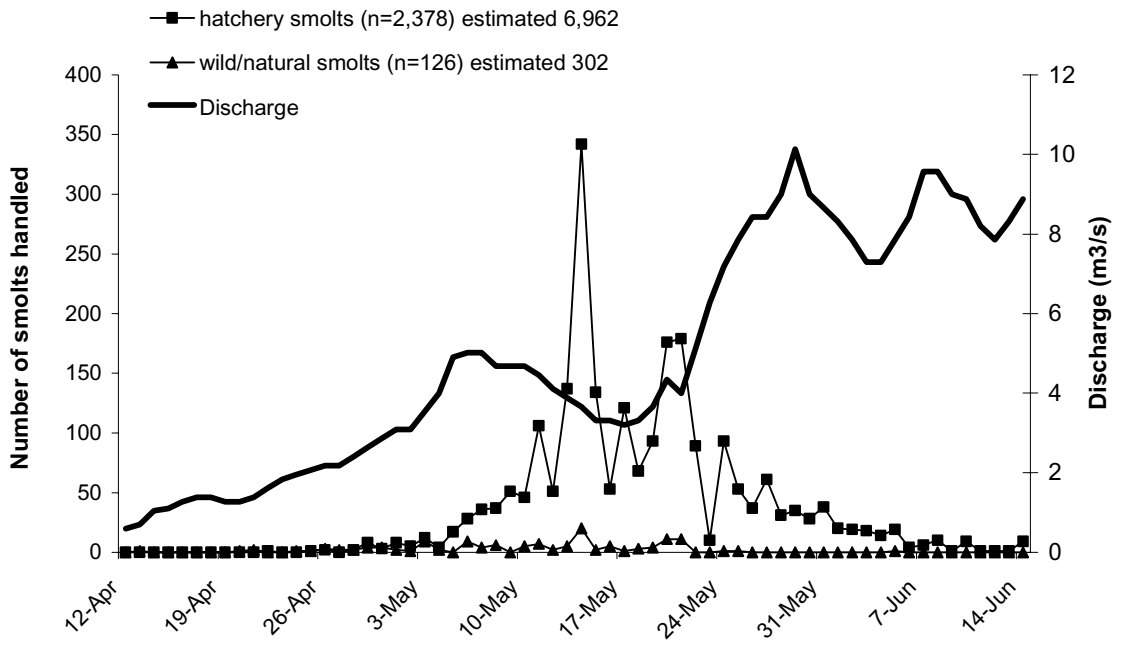

Figure 2. Daily capture of wild/natural and hatchery sockeye salmon smolts and discharge at the Redfish Lake Creek trap during the 2000 out-migration.

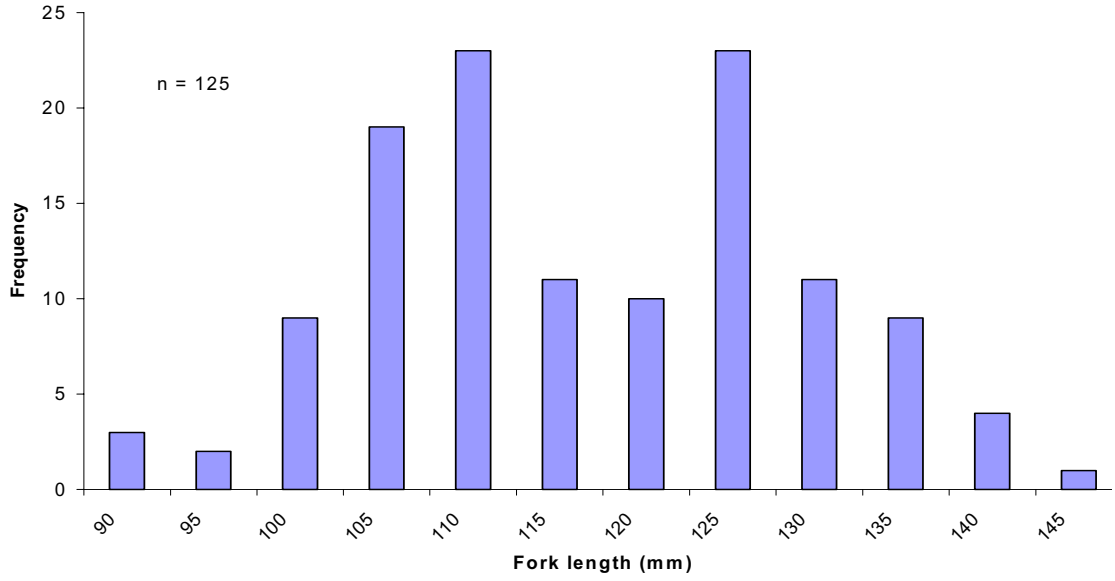

Figure 3. Length frequency of wild/natural sockeye salmon smolts collected at Redfish Lake Creek trap in 2000. Age-1 smolts ranged in length from 85 to 120 mm fork length; age-2 smolts ranged from 120 to 150 mm fork length. Total out-migration estimated at 302 smolts.

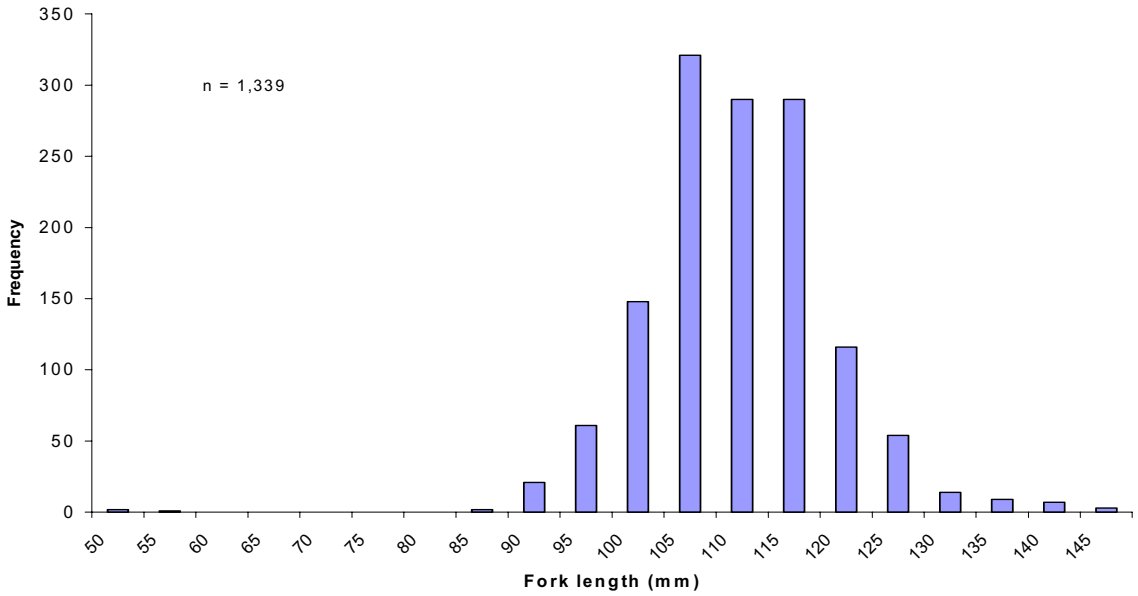

Figure 4. Length frequency of measured hatchery-produced sockeye salmon smolts captured at Redfish Lake Creek trap in 2000. Total out-migration estimated at 6,962 smolts.

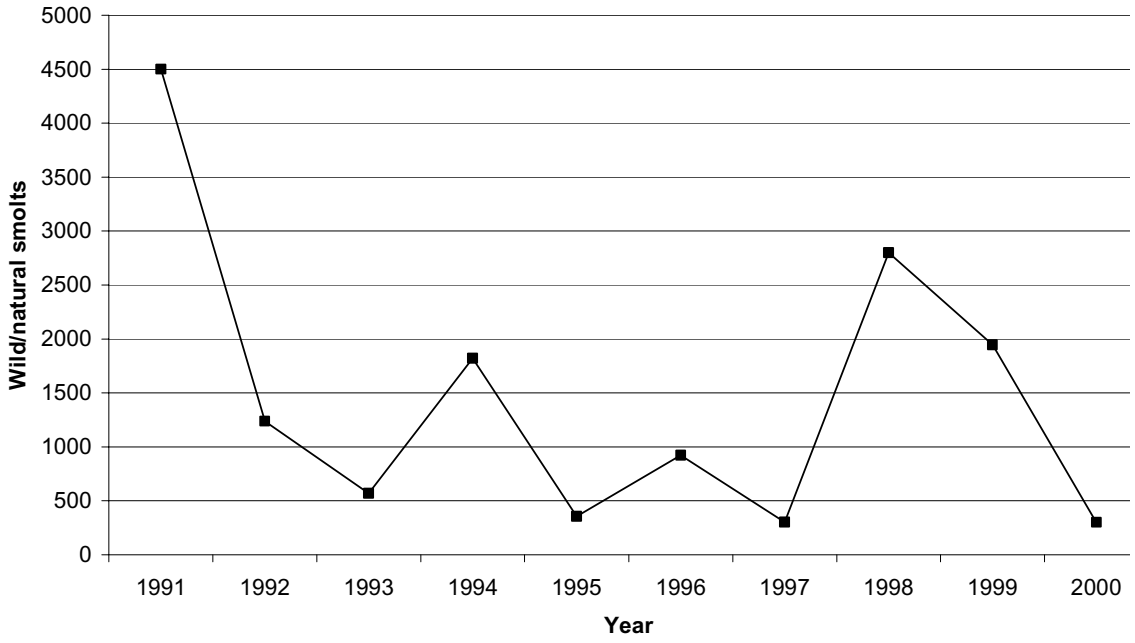

Figure 5. Wild/natural sockeye salmon smolt out-migration estimated at Redfish Lake Creek trap from 1991 to 2000.

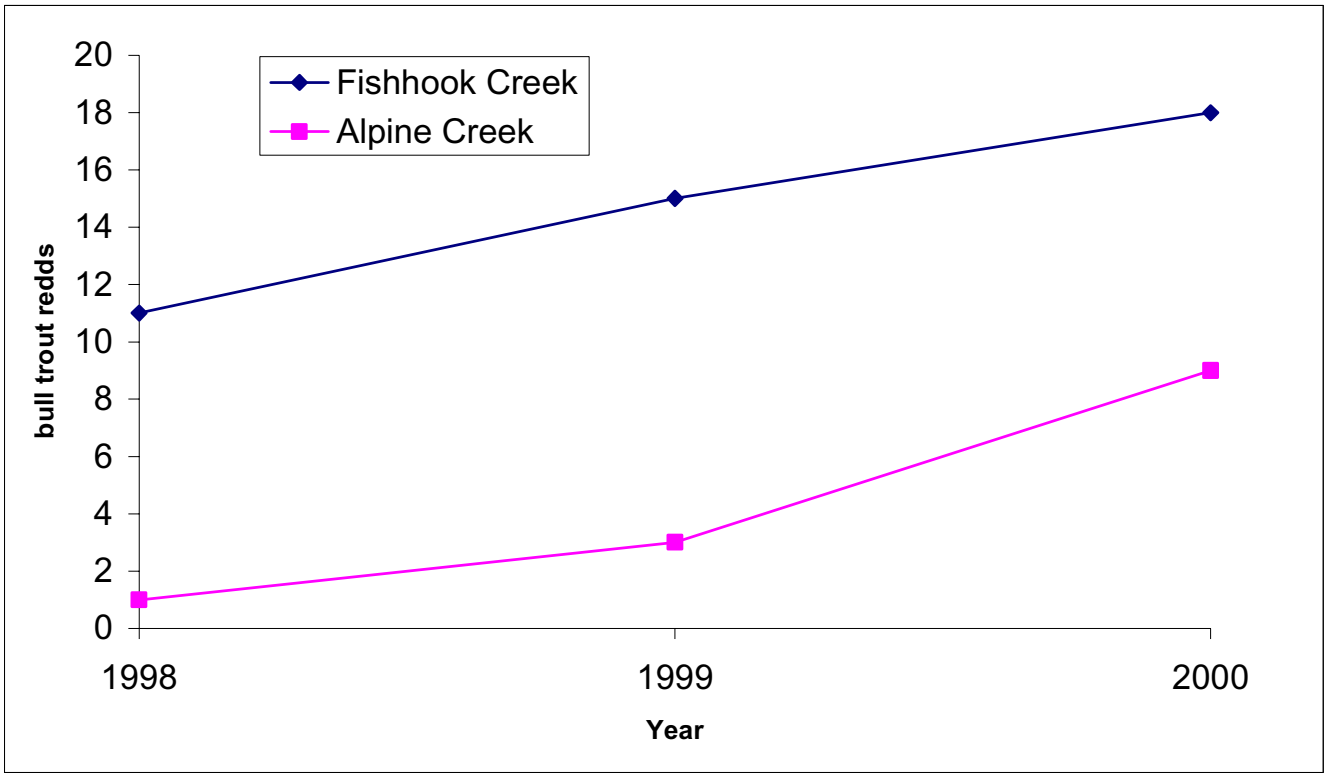

Figure 6. Bull trout redds counted from index reaches of tributaries to Redfish Lake (Fishhook Creek) and Alturas Lake (Alpine Creek) from 1998 to 2000.

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APPENDICES

Appendix A. Fork length (mm) and weight (g) of kokanee captured during midwater trawls conducted in September 2000 on Redfish, Pettit, and Alturas lakes.

Transect	Length	Weight	Age
		Redfish Lake	
3	42	1.1	0
3	47	1.0	0
4	61	2.3	0
5	62	1.9	0
1	63	2.6	0
4	66	2.7	0
5	66	2.7	0
4	75	4.0	0
1	78	3.7	0
5	85	5.9	1
3	91	7.4	1
4	120	18.3	1
		Pettit Lake	
2	112	13.8	1 ad clip sockeye
1	142	26.0	1
4	143	30.0	1
2	150	29.1	1
1	152	35.1	1
2	152	36.9	1
2	152	35.9	1
4	152	39.9	1
2	153	36.3	1
3	153	36.4	1
4	153	29.3	1
2	154	36.2	1
2	155	32.5	1
4	155	33.3	1
1	156	37.4	1
3	156	40.4	1
3	156	35.4	1
4	156	31.4	1
4	156	37.8	1
4	157	36.3	1
1	158	38.6	1
3	158	37.5	1
3	158	32.3	1
4	158	43.1	1
1	159	34.6	1
2	159	38.0	1
2	160	39.7	1
2	160	39.8	1
3	160	40.6	1
3	160	42.9	1
4	160	42.3	1
1	161	42.1	1

Appendix A. (Continued.)

Transect	Length	Weight	Age
1	161	52.0	1
1	161	41.8	1
2	161	42.6	1
2	161	43.7	1 ad-clip sockeye
2	161	33.2	1
2	161	40.5	1
3	161	36.6	1
4	161	41.0	1
4	161	38.8	1
1	162	38.5	1
1	162	37.2	1
2	162	49.5	1
3	162	42.0	1
4	162	39.4	1
1	163	35.6	1
1	163	41.0	1
1	163	40.6	1
4	163	38.8	1
2	164	42.8	1
1	165	36.1	1
2	165	49.7	1
4	165	44.1	1
1	166	41.5	1
1	166	42.4	1
1	167	40.5	1
1	167	53.6	1
1	167	36.3	1
3	167	46.5	1
1	168	38.1	1
3	168	46.3	1
4	168	46.7	1
4	169	54.8	1
4	171	45.3	1
1	172	51.4	1
1	172	49.1	1
2	172	39.3	1
2	173	47.3	1
2	174	46.6	1
3	174	51.3	1
2	175	42.1	1
2	178	51.4	1
2	179	45.2	1
1	182	41.0	1
1	184	57.3	1
		Alturas Lake	
1	41	0.6	0
5	41	0.6	0
4	42	0.7	0

Appendix A. (Continued.)

Transect	Length	Weight	Age
1	44	0.8	0
2	44	0.7	0
3	44	0.8	0
4	44	0.8	0
5	46	0.9	0
3	47	0.9	0
4	47	0.9	0
2	48	1.0	0
3	48	1.0	0
4	48	1.1	0
4	48	0.8	0
5	48	1.0	0
1	49	1.1	0
2	50	1.1	0
3	50	1.1	0
4	50	1.0	0
4	50	1.2	0
4	50	1.4	0
4	50	1.2	0
1	51	1.2	0
2	51	1.2	0
2	51	1.2	0
4	51	1.5	0
4	51	1.3	0
5	51	1.3	0
1	52	1.1	0
3	52	1.2	0
3	52	1.1	0
4	52	1.3	0
4	52	1.4	0
5	52	1.2	0
5	52	1.4	0
5	52	1.3	0
5	52	1.3	0
5	52	1.4	0
3	53	1.3	0
3	53	1.5	0
4	53	1.4	0
4	53	1.4	0
4	53	1.8	0
4	53	1.5	0
5	53	1.2	0
5	53	1.7	0
2	54	1.4	0
3	54	1.3	0
3	54	1.3	0
4	54	1.4	0
4	54	1.3	0

Appendix A. (Continued.)

Transect	Length	Weight	Age
5	54	1.4	0
5	54	1.3	0
1	55	1.2	0
1	55	1.6	0
4	55	1.6	0
4	55	1.6	0
4	55	1.6	0
5	55	1.6	0
5	55	1.5	0
5	55	1.0	0
2	56	1.6	0
4	56	1.7	0
5	56	1.6	0
5	56	1.6	0
3	57	1.7	0
3	57	1.6	0
4	57	1.7	0
4	57	1.7	0
5	57	1.6	0
2	58	0.9	0
2	58	1.6	0
2	58	1.6	0
3	58	1.7	0
4	58	1.9	0
2	59	2.0	0
3	59	2.0	0
4	59	1.8	0
4	59	1.6	0
5	59	1.9	0
2	60	1.9	0
3	60	1.8	0
4	60	1.9	0
4	60	1.9	0
5	60	2.1	0
3	61	2.1	0
4	61	1.9	0
5	61	1.9	0
2	62	2.0	0
3	62	2.1	0
5	62	1.8	0
4	63	2.1	0
2	71	2.9	0
3	71	3.3	0
3	71	3.4	0
1	72	3.2	0
3	72	3.3	0
5	72	4.2	0
5	73	4.4	0

Appendix A. (Continued.)

Transect	Length	Weight	Age
5	74	3.8	0
5	74	3.9	0
1	75	3.9	0
3	75	3.4	0
4	75	3.8	0
5	75	3.7	0
5	75	4.2	0
1	76	3.9	0
1	76	3.9	0
2	76	4.0	0
3	76	4.2	0
3	76	2.3	0
4	76	4.0	0
1	77	4.0	0
2	77	4.2	0
3	77	4.4	0
3	77	4.4	0
5	77	—	0
1	78	4.1	0
5	79	4.9	0
5	79	4.2	0
2	80	4.7	0
2	80	4.7	0
2	80	4.6	0
3	80	4.5	0
4	80	4.2	0
2	81	4.9	1
2	81	4.2	1
4	81	5.3	1
2	82	4.5	1
3	82	4.5	1
3	82	5.0	1
4	82	5.1	1
4	82	6.2	1
5	82	4.6	1
5	82	5.3	1
2	83	5.4	1
2	83	4.6	1
3	83	5.1	1
3	83	4.8	1
4	83	4.9	1
1	84	5.5	1
2	84	5.0	1
3	84	4.4	1
3	84	4.9	1
4	84	5.5	1
3	85	5.4	1
3	85	5.6	1

Appendix A. (Continued.)

Transect	Length	Weight	Age
3	85	5.8	1
4	85	5.4	1
4	85	5.3	1
5	85	6.0	1
5	85	5.4	1
5	85	5.7	1
5	85	5.3	1
2	86	5.6	1
3	86	5.9	1
4	86	5.8	1
5	86	6.1	1
5	86	5.4	1
2	87	6.0	1
2	87	6.1	1
4	87	6.1	1
1	88	5.9	1
3	88	6.3	1
4	88	6.1	1
3	89	6.1	1
2	90	6.9	1
3	90	6.6	1
5	90	7.5	1
5	90	7.3	1
4	91	7.8	1
5	91	5.6	1
1	92	7.5	1
2	92	7.4	1
1	93	6.9	1
3	93	7.0	1
5	93	8.1	1
2	94	8.3	1
5	94	8.3	1
1	95	8.2	1
1	96	8.7	1
2	96	7.0	1
1	97	8.0	1
2	97	8.9	1
4	97	9.1	1
4	98	9.2	1
4	99	7.2	1
2	100	8.9	1
2	100	9.2	1
3	100	7.7	1
4	100	10.0	1
5	100	9.4	1
5	101	10.5	1
1	102	10.0	1
3	102	8.9	1

Appendix A. (Continued.)

Transect	Length	Weight	Age
3	102	9.6	1
4	102	9.6	1
1	103	9.6	1
2	103	9.7	1
2	103	10.8	1
2	103	11.8	1
4	105	12.5	1
2	106	11.3	1
2	106	11.8	1
2	106	10.4	1
5	106	11.2	1
3	107	11.2	1
2	108	12.3	1
4	108	9.7	1
2	109	12.1	1
2	109	13.1	1
5	109	13.0	1
1	110	13.1	1
1	110	12.2	1
4	110	12.6	1
4	110	13.8	1
5	110	12.0	1
2	111	12.5	1
3	111	13.6	1
2	112	14.1	1
5	112	12.6	1
2	113	13.6	1
4	113	14.2	1
4	113	13.6	1
5	113	14.1	1
2	114	13.2	1
2	114	14.2	1
2	114	11.9	1
4	114	—	1
1	115	13.5	1
1	115	13.5	1
3	115	12.2	1
3	115	10.1	1
4	115	10.7	1
4	115	14.7	1
5	115	15.7	1
2	116	14.9	1
2	117	14.8	1
4	117	11.1	1
5	117	16.8	1
3	118	16.0	1
2	119	15.3	1
3	119	12.8	1

Appendix A. (Continued.)

Transect	Length	Weight	Age
2	120	15.7	1
2	120	17.6	1
3	120	16.2	1
4	120	19.1	1
4	120	17.6	1
1	122	16.2	1
4	122	17.6	1
3	123	15.5	1
4	123	17.5	1
4	123	18.5	1
5	123	17.3	1
2	124	16.4	1
2	127	20.4	1
2	127	18.7	1
1	128	18.6	1
2	130	18.7	1
3	137	24.4	1
1	139	26.5	1
3	140	23.0	1
3	140	25.5	1
5	140	26.7	1
5	141	25.6	1
4	142	25.6	1
5	143	25.6	1
1	145	26.7	1
1	146	27.4	1
4	146	27.6	1
1	148	29.9	1
3	149	30.4	1
4	150	30.1	1
4	150	30.4	1
5	150	30.6	1
5	150	29.0	1
4	152	29.7	1
2	154	31.2	1
4	154	33.5	1
4	154	33.2	1
3	158	35.8	2
2	159	36.2	2
2	160	34.6	2
4	160	36.1	2
3	162	40.9	2

Appendix B. Sockeye salmon smolt PIT tag detections at Lower Granite Dam for 2000.

Date	Wild/natural	Redfish	Alturas	Pettit	Totals	Cumulative
05/01/00					0	0
05/02/00	1				1	1
05/03/00					0	1
05/04/00	1				1	2
05/05/00	1				1	3
05/06/00					0	3
05/07/00					0	3
05/08/00	3		4		7	10
05/09/00			6		6	16
05/10/00	1		20	4	25	41
05/11/00	1		8	1	10	51
05/12/00	2		4	1	7	58
05/13/00			3	2	5	63
05/14/00			4		4	67
05/15/00		1	1	3	5	72
05/16/00			2	1	3	75
05/17/00	1	1	8	8	18	93
05/18/00			9	13	22	115
05/19/00			7	4	11	126
05/20/00	1	2	3	10	16	142
05/21/00		2	7	15	24	166
05/22/00		2	6	21	29	195
05/23/00	1	2	6	16	25	220
05/24/00		2	4	31	37	257
05/25/00	1	1	5	38	45	302
05/26/00		3	3	15	21	323
05/27/00		1	2	17	20	343
05/28/00		2		19	21	364
05/29/00		4		13	17	381
05/30/00		2		7	9	390
05/31/00				9	9	399
06/01/00				3	3	402
06/02/00		2	1	6	9	411
06/03/00				1	1	412
06/04/00				1	1	413
06/05/00		1			1	414
06/06/00		2			2	416
06/07/00				2	2	418
06/08/00		2		1	3	421
06/09/00			1		1	422
06/10/00					0	422
06/11/00					0	422
06/12/00					0	422
06/13/00				1	1	423
06/14/00				1	1	424
06/15/00		1		3	4	428
06/16/00					0	428

Appendix B. (Continued.)

Date	Wild/natural	Redfish	Alturas	Pettit	Totals	Cumulative
06/17/00					0	428
06/18/00					0	428
06/19/00		1			1	429
06/20/00					0	429
06/21/00					0	429
06/22/00					0	429
06/23/00					0	429
06/24/00					0	429
06/25/00				1	1	430
06/26/00					0	430
06/27/00		1			1	431
06/28/00		2			2	433
06/29/00					0	433
06/30/00		1			1	434
07/01/00			1	1	2	436
07/02/00					0	436
07/03/00					0	436
07/04/00					0	436
07/05/00					0	436
07/06/00		2			2	438
07/07/00			1		1	439
07/08/00		2			2	441
07/09/00			1		1	442
Totals	**14**	**42**	**117**	**269**		
Grand Total			**442**			

Appendix C. Number of PIT-tag detections for sockeye salmon smolts detected at Lower Granite Dam estimated from daily collection efficiency (DCE).

Date	kcfs Flow	kcfs Spill	% Spill	DCE	Wild/natural	Redfish	Alturas	Pettit	Total
05/01/00	92.4	22.6	24%	0.332	0	0	0	0	0
05/02/00	92.5	22.4	24%	0.342	3	0	0	0	3
05/03/00	97.7	23.4	24%	0.372	0	0	0	0	0
05/04/00	96.8	23.8	25%	0.376	3	0	0	0	3
05/05/00	99.3	24.0	24%	0.407	2	0	0	0	2
05/06/00	96.3	23.1	24%	0.401	0	0	0	0	0
05/07/00	88.5	22.0	25%	0.407	0	0	0	0	0
05/08/00	83.0	21.2	26%	0.417	7	0	10	0	17
05/09/00	76.1	19.0	25%	0.388	0	0	15	0	15
05/10/00	79.7	20.1	25%	0.389	3	0	51	10	64
05/11/00	81.9	20.4	25%	0.333	3	0	24	3	30
05/12/00	78.5	20.1	26%	0.297	7	0	13	3	24
05/13/00	72.7	18.6	26%	0.263	0	0	11	8	19
05/14/00	70.8	17.9	25%	0.283	0	0	14	0	14
05/15/00	69.7	17.8	26%	0.404	0	2	2	7	12
05/16/00	62.3	16.7	27%	0.294	0	0	7	3	10
05/17/00	67.0	17.8	27%	0.259	4	4	31	31	69
05/18/00	68.9	17.3	25%	0.303	0	0	30	43	73
05/19/00	73.4	18.3	25%	0.263	0	0	27	15	42
05/20/00	76.5	19.5	25%	0.262	4	8	11	38	61
05/21/00	79.9	20.0	25%	0.27	0	7	26	56	89
05/22/00	87.6	22.0	25%	0.298	0	7	20	70	97
05/23/00	99.1	23.6	24%	0.362	3	6	17	44	69
05/24/00	95.1	23.0	24%	0.37	0	5	11	84	100
05/25/00	92.0	21.6	23%	0.387	3	3	13	98	116
05/26/00	89.9	21.5	24%	0.348	0	9	9	43	60
05/27/00	87.2	20.5	24%	0.331	0	3	6	51	60
05/28/00	87.2	20.8	24%	0.297	0	7	0	64	71
05/29/00	88.9	28.1	32%	0.252	0	16	0	52	67
05/30/00	86.3	29.8	35%	0.264	0	8	0	27	34
05/31/00	85.6	31.8	37%	0.173	0	0	0	52	52
06/01/00	82.2	31.8	39%	0.114	0	0	0	26	26
06/02/00	76.0	32.4	43%	0.136	0	15	7	44	66
06/03/00	72.7	33.0	45%	0.14	0	0	0	7	7
06/04/00	69.0	30.9	45%	0.102	0	0	0	10	10
06/05/00	74.2	30.0	40%	0.151	0	7	0	0	7
06/06/00	85.9	31.8	37%	0.142	0	14	0	0	14
06/07/00	86.0	31.7	37%	0.179	0	0	0	11	11
06/08/00	83.1	31.7	38%	0.189	0	11	0	5	16
06/09/00	73.8	32.3	44%	0.136	0	0	7	0	7
06/10/00	68.9	32.5	47%	0.115	0	0	0	0	0
06/11/00	65.9	32.4	49%	0.206	0	0	0	0	0
06/12/00	62.8	30.4	48%	0.102	0	0	0	0	0
06/13/00	70.1	30.2	43%	0.364	0	0	0	3	3
06/14/00	75.8	30.3	40%	0.18	0	0	0	6	6
06/15/00	78.2	30.9	40%	0.192	0	5	0	16	21
06/16/00	77.7	30.3	39%	0.231	0	0	0	0	0
06/17/00	66.8	28.8	43%	0.099	0	0	0	0	0
06/18/00	57.3	27.6	48%	0.2	0	0	0	0	0

Appendix C. (Continued.)

	Kcfs								
	Flow	**Spill**	**% Spill**	**DCE**	**Wild/natural**	**Redfish**	**Alturas**	**Pettit**	**Total**
06/19/00	62.4	30.4	49%	0.166	0	6	0	0	6
06/20/00	59.7	15.1	25%	0.248	0	0	0	0	0
06/21/00	55.4	0.0	0%	0.492	0	0	0	0	0
06/22/00	53.4	0.0	0%	0.555	0	0	0	0	0
06/23/00	50.4	0.0	0%	0.709	0	0	0	0	0
06/24/00	44.3	0.0	0%	0.677	0	0	0	0	0
06/25/00	40.2	0.0	0%	0.7	0	0	0	1	1
06/26/00	41.7	0.0	0%	0.765	0	0	0	0	0
06/27/00	45.7	0.0	0%	0.743	0	1	0	0	1
06/28/00	42.7	0.0	0%	0.697	0	3	0	0	3
06/29/00	38.5	0.0	0%	0.706	0	0	0	0	0
06/30/00	41.2	0.0	0%	0.724	0	1	0	0	1
07/01/00	36.0	0.0	0%	0.676	0	0	1	1	3
07/02/00	33.6	0.0	0%	0.697	0	0	0	0	0
07/03/00	35.8	0.0	0%	0.727	0	0	0	0	0
07/04/00	34.5	0.0	0%	0.768	0	0	0	0	0
07/05/00	36.0	0.0	0%	0.727	0	0	0	0	0
07/06/00	38.5	0.0	0%	0.749	0	3	0	0	3
07/07/00	39.6	0.0	0%	0.712	0	0	1	0	1
07/08/00	37.4	0.0	0%	0.747	0	3	0	0	3
07/09/00	44.0	0.0	0%	0.724	0	0	1	0	1
Totals					**41**	**152**	**367**	**934**	**1,493**

Appendix D. Anadromous sockeye salmon returns to the Sawtooth basin in 2000. Fish were grouped by final release location, either Sawtooth Fish Hatchery (SFH) or Redfish Lake Creek (RFLC). Marks included fin clips: adipose fin (AD), left vent (LV), and presence of coded-wire tags (CWT).

Trap Date	Return Location	Sex	Fork Length (cm)	Marks	Injuries	Assigned PIT #	Comments
				Alturas Lake			
7/27/00	SFH	M	57	AD/LV/CWT	-	515C1F1973	
7/27/00	SFH	M	59	AD/LV	-	7F7B094538	No CWT
7/28/00	SFH	F	51	AD/LV	-	515C247C6F	No CWT
7/30/00	SFH	M	56	AD/LV	-	515C623B11	No CWT
7/31/00	SFH	F	54	AD/LV	-	7F7B080C1A	No CWT
8/1/00	SFH	M	54	AD/LV/CWT	-	515C1D2622	
8/2/00	SFH	M	56	AD/LV/CWT	-	515A78342D	
8/2/00	SFH	M	55	AD/LV/CWT	-	515C1F1222	
8/2/00	SFH	M	52	AD/LV/CWT	-	515C275F08	
8/2/00	SFH	F	55	AD/LV	-	7F7B076548	No CWT
8/3/00	SFH	M	55	AD/LV/CWT	-	515A7A7029	
8/3/00	SFH	F	57	AD	-	515C5D4E7F	
8/4/00	SFH	F	54	AD/LV/CWT	-	515A650473	
8/4/00	SFH	M	53	AD/LV/CWT	-	515C200502	
8/4/00	SFH	M	53	AD/LV/CWT	-	515C220A2E	
8/4/00	SFH	M	53	AD/LV/CWT	-	515C22534C	
8/4/00	SFH	F	52	AD/LV/CWT	-	515C2A6D0E	
8/4/00	SFH	M	52	AD	-	7F7B08463C	
8/4/00	SFH	M	49	AD/LV	-	7F7B0B0159	No CWT
8/5/00	SFH	F	52	AD/LV/CWT	-	515C1E2F34	
8/5/00	SFH	F	49	AD/LV/CWT	-	515C265340	
8/5/00	SFH	M	54	AD/LV/CWT	-	515C36457C	
8/5/00	SFH	F	53	AD/LV/CWT	-	515C635339	U of I Radio
8/6/00	SFH	M	52	AD/LV/CWT	-	515C255941	
8/6/00	SFH	F	53	AD/LV/CWT	Gill Net	515C273500	
8/6/00	SFH	M	55	AD/LV/CWT	-	515C2A000B	
8/6/00	SFH	F	52	AD/LV/CWT	-	515C2A7702	
8/6/00	SFH	M	57	AD/LV	-	515C374F1A	No CWT
8/6/00	SFH	M	54	AD/LV/CWT	-	7F7B093571	
8/7/00	SFH	M	52	AD/LV/CWT	-	515C241E21	
8/7/00	SFH	M	50	AD/LV	-	7F7B094167	No CWT
8/7/00	SFH	M	57	AD/LV	-	7F7B097252	No CWT
8/8/00	SFH	M	57	AD/LV/CWT	-	7F7B097B26	
8/8/00	SFH	M	56	AD/LV/CWT	-	7F7B0A001A	
8/8/00	SFH	F	54	AD	-	2036137E19	
8/10/00	SFH	F	54	AD	-	20365F6269	Prespawn mortality
8/10/00	SFH	M	57	AD/LV	-	20370D4C50	
8/11/00	SFH	M	55	AD	-	2036071E05	
8/11/00	SFH	M	53	AD/LV	-	20367D614C	
8/11/00	SFH	F	54	AD	-	2037747A3B	
8/12/00	SFH	F	55	AD	-	203766192A	
8/13/00	SFH	M	58	AD/LV/CWT	L. Eye	2036164252	
8/13/00	SFH	M	55	AD/LV/CWT	-	2037135244	
8/14/00	SFH	M	59	AD	-	20362E7B01	
8/16/00	SFH	M	53	AD/LV/CWT	-	2037460B58	
8/16/00	SFH	M	54	AD/RV	R. Eye	20376F7842	Right eye missing
8/17/00	SFH	F	54	AD/LV/CWT	-	20374B332B	
8/17/00	SFH	M	54	AD/LV/CWT	-	20374D4913	
8/18/00	SFH	M	55	AD/LV/CWT	-	203673684F	
8/18/00	SFH	M	56	AD/LV/CWT	-	2037761F14	
8/21/00	SFH	M	53	AD/LV	-	7F7B08680B	

Appendix D. (Continued.)

Trap Date	Return Location	Sex	Fork Length (cm)	Marks	Injuries	Assigned PIT #	Comments
8/22/00	SFH	M	61	AD/LV	-	2037122671	
9/2/00	SFH	F	55	AD	-	20370E7229	
				Pettit Lake			
7/26/00	SFH	F	55	AD/LV	-	515C25681F	No CWT
7/26/00	SFH	F	50	AD/LV	-	515C51BF03	No CWT
7/26/00	SFH	M	56	AD/LV	-	7F7B034859	No CWT
7/29/00	SFH	M	54	AD/LV	-	516C203668	No CWT
7/31/00	SFH	M	54	AD/LV	-	515C2C1C42	No CWT
8/1/00	SFH	M	55	AD/LV/CWT	-	515C610660	
8/1/00	SFH	M	58	AD/LV/CWT	-	7F7B03792A	
8/3/00	SFH	M	55	AD/LV	-	515C2F7300	No CWT
8/3/00	SFH	M	53	AD/LV/CWT	-	7F7B090742	
8/3/00	SFH	M	55	AD	-	7F7B0A7E24	
8/4/00	SFH	M	54	AD/LV/CWT	Puncture	515C33181C	Dorsal Surface puncture
8/6/00	SFH	F	55	AD/LV/CWT	-	515C64321F	
8/8/00	SFH	M	52	AD/LV/CWT	-	7F7B08644A	
8/8/00	SFH	M	56	AD/LV/CWT	-	2036636F58	
8/8/00	SFH	M	53	AD/LV	-	20373B5519	
8/11/00	SFH	M	54	AD/LV/CWT	-	2036077132	
8/11/00	SFH	M	53	AD/LV/CWT	-	2036624602	
8/11/00	SFH	M	50	AD/LV	-	203669467B	
8/12/00	SFH	M	54	AD	-	2036163262	
8/13/00	SFH	F	54	AD	-	20373A0A65	
8/13/00	SFH	F	54	AD/LV/CWT	-	203761794F	
8/15/00	SFH	M	53	AD	-	20360D4A53	
8/15/00	SFH	F	58	AD	-	2036701129	
8/15/00	SFH	M	57	AD/LV/CWT	-	2037427077	U of I Radio
8/19/00	SFH	M	57	AD/LV/CWT	-	416D2E7712	
8/21/00	SFH	F	53	AD	-	2037087829	
8/23/00	SFH	F	54	AD	-	2037405F0A	
8/30/00	SFH	F	56	AD	-	2036037F28	
				Redfish Lake			
7/22/00	RFLC	F	54	AD/LV/CWT	-	416C414561	
7/22/00	RFLC	F	56	AD/LV/CWT	-	416E49607B	
7/25/00	RFLC	F	56	AD/LV	-	416D057949	No CWT
7/25/00	RFLC	F	53	NONE	-	7F7F53451B	
7/26/00	RFLC	F	57	AD/LV	-	416E2E012B	No CWT
7/27/00	RFLC	F	55	NONE	-	1F295B706D	
7/28/00	RFLC	F	55	AD/LV	-	1F457B3071	No CWT
7/28/00	RFLC	F	56	AD	-	416C076E39	
7/28/00	RFLC	M	54	AD/LV	-	416E0E4371	No CWT
7/28/00	RFLC	F	51	AD/LV	-	417057402F	No CWT
7/29/00	RFLC	F	52	AD/LV/CWT	-	416B697727	
7/29/00	RFLC	F	52	AD/LV	-	416C77335B	No CWT
7/29/00	RFLC	F	59	AD/LV	-	416F28391F	No CWT
7/29/00	RFLC	F	57	AD/LV/CWT	-	516037794A	U of I Radio
7/30/00	RFLC	M	53	AD/LV	-	200D671458	No CWT
7/30/00	RFLC	M	54	AD/LV	-	41704B601B	No CWT
7/30/00	RFLC	F	52	AD/LV/CWT	-	7F7D0E5976	
7/31/00	RFLC	F	54	AD/LV	-	200E22614F	No CWT
7/31/00	RFLC	F	52	AD/LV/CWT	-	2036360173	
7/31/00	RFLC	F	50	AD/LV	-	416F1D1523	No CWT
7/31/00	RFLC	M	57	AD/LV/CWT	-	416F593240	
8/1/00	RFLC	M	51	AD/LV/CWT	-	416D160A45	
8/2/00	RFLC	M	54	AD/LV	-	416D0D2545	No CWT
8/2/00	RFLC	M	56	AD/LV/CWT	-	416F1A6B30	
8/2/00	RFLC	M	55	AD/LV/CWT	-	4170650F7A	

Appendix D. (Continued.)

Trap Date	Return Location	Sex	Fork Length (cm)	Marks	Injuries	Assigned PIT #	Comments
8/3/00	RFLC	M	55	AD/LV	Inflamed Vent	1F45790A19	No CWT
8/3/00	RFLC	M	57	AD/LV/CWT	-	2037364620	
8/3/00	RFLC	M	53	AD/LV/CWT	-	223F40545C	
8/3/00	RFLC	M	54	NONE	-	416B610463	
8/3/00	RFLC	M	57	AD/LV	-	416D120C67	No CWT
8/3/00	RFLC	M	54	AD/LV/CWT	-	416D2F0849	
8/3/00	RFLC	M	55	AD/LV	-	41705C2837	No CWT
8/3/00	RFLC	F	53	AD/LV	-	515B4E1806	No CWT
8/3/00	RFLC	M	56	AD/LV/CWT	-	7F7F535D08	
8/4/00	RFLC	F	55	AD	-	416D7E606C	
8/4/00	RFLC	M	60	AD	-	7F7B087570	
8/5/00	RFLC	M	55	AD/LV	-	200D7E0C49	No CWT
8/5/00	RFLC	M	52	AD/LV	-	200E031C33	No CWT
8/5/00	RFLC	M	55	AD/LV/CWT	-	20366C7C42	
8/5/00	RFLC	M	58	AD	-	416D026C71	
8/5/00	RFLC	M	57	AD/LV/CWT	-	416D124458	
8/5/00	RFLC	M	50	AD/LV/CWT	-	416F0A131E	
8/6/00	RFLC	F	55	AD/LV/CWT	-	416C52445D	
8/6/00	RFLC	F	54	AD/LV/CWT	-	416C6B753B	
8/6/00	RFLC	F	53	AD/LV/CWT	-	416E117818	
8/6/00	RFLC	M	56	AD/LV/CWT	-	416E18785A	
8/6/00	RFLC	M	56	NONE	-	416E6B600B	
8/6/00	RFLC	M	56	AD/LV	-	7F7F534876	No CWT
8/7/00	RFLC	F	52	AD/LV	-	2017523D3A	No CWT
8/7/00	RFLC	F	54	AD/LV/CWT	-	2018697867	
8/7/00	RFLC	M	55	AD/LV	-	201C01152E	No CWT
8/7/00	RFLC	M	53	AD/LV	-	201C0E5264	No CWT
8/7/00	RFLC	M	55	AD/LV/CWT	-	7F7D0D0826	
8/7/00	RFLC	F	57	NONE	-	7F7F535326	
8/8/00	RFLC	M	58	AD/LV/CWT	-	1F7B7C7D6D	
8/8/00	RFLC	M	53	AD/LV/CWT	-	20377A210E	
8/8/00	RFLC	M	52	AD/LV	R. Eye	416D6E153D	Right Eye/no cwt
8/8/00	RFLC	M	56	AD/LV/CWT	-	416F514F6C	
8/9/00	RFLC	F	51	AD/LV/CWT	-	2036305822	
8/9/00	RFLC	M	56	AD	-	20374D7369	
8/9/00	RFLC	M	54	AD/LV	-	203767142E	
8/9/00	RFLC	M	55	AD/LV	-	20377A7639	No CWT
8/10/00	RFLC	M	53	AD/LV/CWT	-	416C241F7A	
8/11/00	RFLC	M	56	AD	-	2037690B35	
8/12/00	RFLC	M	59	NONE	-	20374D4E0E	
8/12/00	RFLC	M	55	AD/LV/CWT	-	2037600049	
8/12/00	RFLC	M	54	AD/LV	-	416C701E58	
8/13/00	RFLC	M	52	AD/LV/CWT	-	2036143066	
8/13/00	RFLC	M	55	AD/LV/CWT	-	203657054E	
8/13/00	RFLC	F	56	AD	-	20366B0B34	
8/13/00	RFLC	M	53	AD/LV/CWT	-	2037366D06	
8/13/00	RFLC	M	58	AD/LV	-	2037682819	
8/13/00	RFLC	M	57	AD/LV/CWT	-	416D684551	
8/13/00	RFLC	M	54	AD/LV	-	416F3A0B5D	
8/14/00	RFLC	M	55	AD/LV/CWT	-	20360E5547	U of I Radio
8/14/00	RFLC	M	54	AD/LV	-	20363E7478	No CWT
8/14/00	RFLC	F	56	AD/LV/CWT	-	20364D5508	
8/14/00	RFLC	F	53	AD	-	20376E4873	
8/15/00	RFLC	M	54	AD/LV/CWT	-	20360B227D	
8/15/00	RFLC	M	54	AD/LV	-	2036452A3B	
8/15/00	RFLC	F	54	AD/LV	-	203769360A	
8/16/00	RFLC	M	55	AD/LV/CWT	-	20372F1862	

Appendix D. (Continued.)

Trap Date	Return Location	Sex	Fork Length (cm)	Marks	Injuries	Assigned PIT #	Comments
8/16/00	RFLC	M	53	AD/LV/CWT	-	2037313840	U of I Radio
8/16/00	RFLC	M	55	AD/LV/CWT	-	20375B5876	U of I Radio
8/17/00	RFLC	F	55	AD	-	2036486B77	
8/17/00	RFLC	M	55	AD/LV	-	203666467E	
8/18/00	RFLC	F	52	AD/LV/CWT	-	20361A6030	
8/18/00	RFLC	M	57	AD/LV/CWT	Hook	20373C600D	Hook in mouth
8/19/00	RFLC	M	52	AD/LV/CWT	-	2036574211	
8/21/00	RFLC	M	52	AD/LV/CWT	-	2036463F25	
8/26/00	RFLC	M	55	AD	-	203734482D	
8/27/00	RFLC	M	59	AD/LV	-	2036127226	
8/27/00	RFLC	M	51	AD/LV/CWT	Scar	20362C1265	
8/27/00	RFLC	F	52	AD/LV/CWT	-	203637254E	
8/27/00	RFLC	F	54	AD	-	416F183D7E	
8/31/00	RFLC	F	55	AD/LV/CWT	-	20362A750B	
7/25/00	SFH	F	56	AD/LV/CWT	-	515A6C233E	
7/26/00	SFH	M	57	AD/LV	-	515C266A58	No CWT
7/29/00	SFH	F	54	AD	Nitrogen Burn	515C32304D	
7/29/00	SFH	M	58	AD/LV	-	515F7D7379	No CWT
7/29/00	SFH	M	52	AD/LV/CWT	-	7F7B021D14	
8/2/00	SFH	M	53	AD/LV	-	515A661F2F	No CWT
8/3/00	SFH	M	57	AD/LV	-	515C243747	No CWT
8/3/00	SFH	F	55	AD	-	515C284221	
8/3/00	SFH	M	56	AD/LV/CWT	-	515C501A21D	
8/3/00	SFH	F	56	AD/LV	-	515C583411	No CWT
8/3/00	SFH	F	56	AD/LV	Puncture	7F7B034A15	No CWT/puncture
8/6/00	SFH	M	56	AD/LV/CWT	-	7F7B02485B	
8/7/00	SFH	M	53	AD/LV	-	515C2B6768	No CWT
8/18/00	SFH	M	58	AD/LV/CWT	-	20365D3A13	
8/25/00	SFH	F	55	AD/LV/CWT	-	1F295D1645	
8/28/00	SFH	M	55	AD/LV/CWT	-	2036310574	
9/2/00	SFH	M	57	AD/LV	-	203748372A	
				Eagle Fish Hatchery			
7/27/00	RFLC	F	54	AD/LV/CWT	-	416C63602B	
7/27/00	RFLC	M	57	AD/LV/CWT	-	7F7F581079	
7/29/00	RFLC	M	57	AD/LV/CWT	-	416C49123C	
8/1/00	RFLC	M	58	AD/LV/CWT	-	201B05764A	
8/2/00	RFLC	F	54	AD/LV/CWT	-	416D34245E	
8/3/00	RFLC	F	55	NONE	Mandible	1F45582024	Torn mandible
8/3/00	RFLC	F	53	AD	-	416C3B4151	
8/4/00	RFLC	M	52	NONE	-	1F7C060C53	
8/4/00	RFLC	M	59	AD	-	4170517423	
8/5/00	RFLC	M	56	AD/LV/CWT	-	416C313A34	
8/6/00	RFLC	F	54	NONE	-	1F45632F0A	H25 haplotype
8/6/00	RFLC	F	54	AD	-	1F47433A1D	
8/6/00	RFLC	M	55	AD	-	416D443519	
8/6/00	RFLC	F	55	AD/LV/CWT	-	416E033E45	
8/8/00	RFLC	M	53	AD/LV/CWT	-	2036281C66	
8/10/00	RFLC	F	51	NONE	-	20362E6F0D	H25 haplotype
8/11/00	RFLC	F	50	AD/LV/CWT	-	2036594E03	Prespawn mort
8/12/00	RFLC	F	54	AD/LV/CWT	-	416E56103B	
8/13/00	RFLC	F	54	AD	Puncture	2036261C68	
8/13/00	RFLC	M	58	AD/LV/CWT	-	20373B2846	
8/13/00	RFLC	M	54	AD	-	2037573D15	
8/16/00	RFLC	M	58	AD/LV/CWT	-	1F455D5768	
8/20/00	RFLC	M	52	AD/LV/CWT	-	2036316514	PIT# 222D1F4929
7/22/00	SFH	M	57	AD/LV/CWT	-	515C1E453C	
7/27/00	SFH	M	54	AD/LV/CWT	-	515A6E3B61	

Appendix D. (Continued.)

Trap Date	Return Location	Sex	Fork Length (cm)	Marks	Injuries	Assigned PIT #	Comments
7/27/00	SFH	M	53	AD/LV/CWT	-	515C255F6F	
7/27/00	SFH	M	56	AD/LV/CWT	-	7F7B092221	
7/30/00	SFH	M	54	AD	-	515C1E2368	
7/31/00	SFH	F	55	AD	-	515C335C7F	
8/1/00	SFH	F	53	AD/LV/CWT	-	7F7B0A0F49	
8/3/00	SFH	M	57	AD/LV/CWT	-	7F7B0A0C15	
8/4/00	SFH	M	53	AD/LV/CWT	-	515C234508	PIT# 223829287E
8/6/00	SFH	F	58	AD	-	7F7B021A4E	
8/7/00	SFH	M	55	AD/LV/CWT	-	515A64724D	
8/7/00	SFH	F	54	AD/LV/CWT	-	7F7B08777B	
8/8/00	SFH	M	55	AD	-	515C381650	
8/12/00	SFH	F	53	AD	-	20363B046B	PIT# 22407C521B
8/13/00	SFH	M	51	AD/LV/CWT	-	2036580E44	PIT# 222D1D621C
8/15/00	SFH	M	54	AD/LV/CWT	-	2036271271	
8/17/00	SFH	M	55	AD/LV	-	2036281270	H14 haplotype
8/18/00	SFH	F	54	AD/LV/CWT	-	203742481F	
8/21/00	SFH	F	58	AD	-	2036410465	
8/23/00	SFH	M	59	AD/LV/CWT	-	20370E3A61	

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